



**Verified Carbon
Standard**

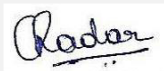
BOOMITRA GRASSLAND RESTORATION IN NORTHERN MEXICO



Document Prepared by 4K Earth Science Private Limited

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Report Title	Validation Report for “Boomitra Grassland Restoration in Northern Mexico”
Client	Boomitra Inc
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Summary:

A brief description of the validation and the project

4K Earth Science Pvt Ltd has carried out the validation of the **Boomitra Grassland Restoration in Northern Mexico** project under the VCS Program. The project is an Improved Grassland Management (IGM) activity, under the Agricultural Land Management (ALM) category, implemented in the region of Mexican deserts to promote sustainable and improved grazing practices within grasslands and to generate GHG removals through mainly soil carbon sequestration. The project has been designed as a grouped project with the aim to incorporate more ranchers adopting improved grazing practices across the project area.

The overall purpose of this project initiative is to develop soil carbon storage through improved grassland management and expected to result in significant removal of CO₂ from the atmosphere, as documented using the VCS methodology, "VM0042 – Methodology for Improved Agricultural Land Management, V1". The project start date is **4th September 2018**, with a 20-year crediting period, until **3rd September 2038**. With expected annual removals of approximately 1,233,480 tCO_{2e}/year on average, eventually the project is estimated to remove about 24,669,598 tons CO_{2e} over the crediting period of 20 years.

The purpose and scope of validation

4KES has been contracted by Boomitra Inc to perform a validation of the VCS grouped project '**Boomitra Grassland Restoration in Northern Mexico**', in Mexico (VCS Ref. No. 2887) in Mexico.

The validation's goal is to ensure that the "**Boomitra Grassland Restoration in Northern Mexico Project**" and all associated project documentation complies with all guidelines and specifications of the VCS Standard v4.4, VCS Methodology Requirements, the applied GHG methodology "**VCS VM0042 Methodology for Improved Agricultural Land Management, Version 1**" and its accompanying tools and modules, as well as

the VCS Non-Permanence Risk Tool, v4, and VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities (version 3.0).

The method and criteria used for validation

The scope of the validation is defined as an independent and objective review of the VCS project design document, the project's baseline study, monitoring plan and other relevant documents. The information in these documents is reviewed against the requirements of 'VCS Validation and Verification Manual v3.2', VCS Standard v4.4 and all other associated VCS requirements and rules.

The report is based on the assessment of the VCS project design document, application of standard auditing techniques including but not limited to desk review, site visits and follow up actions and the review of the applicable approved methodological and relevant tools. The validation procedure was free of any uncertainties.

The number of findings raised during validation

During the validation process 69 corrective actions (CARs), 15 clarification requests (CLs) and 05 Forward action request (FAR)¹ concerning validation were raised.

Summary of the validation conclusion

In conclusion, according to 4KES, the project **"Boomitra Grassland Restoration in Northern Mexico", in Mexico** satisfies all pertinent requirements for VCS standards and guidelines and correctly implements the approved VCS methodology for calculating baseline, determining additionality, and monitoring emission reductions throughout its entire crediting period, which starts on 4th September 2018, and ends on 3rd September 2038.

¹ FAR 04 and 05 has been added and FAR 02 has been closed during VCS PRR review process.

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1 INTRODUCTION

1.1 Objective

4KES has been contracted by “**Boomitra Inc²**” to perform a validation of the VCS project ‘Boomitra Grassland Restoration in Northern Mexico’, (VCS Ref. No. 2887)³ in Mexico.

The objective of the validation is defined as an independent third-party assessment of the VCS project and its design document, the project’s baseline study, additionality, monitoring plan, VCS requirements, relevant rules and host country regulations and other relevant documents. The information in these documents is reviewed against the requirements of ‘VCS Validation and Verification Manual v3.2’ and all other associated VCS requirements and rules. Validation is seen as necessary to provide assurance to stakeholders on the quality of the project and its intended generation of Verified Carbon Units (VCUs) / Emission reductions.

All VCS projects must undergo independent third-party validation in order to assure the VCS and other stakeholders of the project's quality and anticipated Verified Carbon Units (VCUs) from the project.

1.2 Scope and Criteria

The scope of the validation is defined as an independent and objective review of the Project description/7/ document, where methodological deviations and the project’s compliance in relevant sections of PD is reviewed against the requirements of VCS Standard. 4KES has employed a risk-based approach in the validation, focusing on the identification of significant risks for project implementation and the generation of Emission Reductions/carbon sequestration.

The scope of work covered in the validation is described below:

- To validate whether the project activity meets the requirements of VCS Standard v4.4/2/, VCS Validation and Verification Manual v3.2/3/, and VCS program guide 4.3 /1/.
- To evaluate whether the baseline and monitoring plan are in conformance with the applied VCS methodology.
- Approved baseline and monitoring methodologies (including GHG inventories).
- To confirm that the information presented are completed, consistent, transparent and free of omission or material error.
- Background investigation and follow up interviews and site visit.
- Issuance of draft validation report with CARs, CLs & FARs, if any
- Final validation opinion
- Standard auditing methods for management systems.

² Initial contract was signed with ConserWater Technologies Inc. doing business as Boomitra. During the course of validation, the name ‘ConserWater Technologies Inc’ has been changed by PP to Boomitra.

³ <https://registry.terra.org/app/projectDetail/VCS/2887>

- Good practice in the respective technology and sectoral scope, including environmental and social impacts and sustainable developmental goals.

Furthermore, the assessment team used additional documentation by third parties like reports referring to the project design or to the basic conditions and technical data available on public domain to assess the following: -

- Compliance with relevant law and regulations
- LULC data /15/
- Land title documents (issued by the competent authorities in the region /17/ and carbon agreements between the landowners and PP /36/)
- Project database /8/
- AFOLU safeguards section in PD/7/

The assessment team has checked all the above-mentioned details and confirms that all the information provided is accurate. Unless otherwise indicated, the assessment was performed against the most recent version of the relevant VCS guidance document.

The validation is not intended to give the client any consulting. However, clearly stated requests for clarifications and/or remedial action may provide opportunity for client for enhancing the project design and its applicability as per VCS requirements.

1.3 Level of Assurance and Reasonableness of Assumptions

The assessment was conducted to provide a reasonable level of assurance of conformance against the defined audit criteria and materiality thresholds within the audit scope. Based on the audit findings, a positive evaluation statement reasonably assures that the project GHG assertions are materially correct and is a fair representation of the GHG data and information.

In accordance with Section 4.1.2 of the VCS Standard v4.4, the level of assurance/ assumptions of this validation report is reasonable.

1.4 Summary Description of the Project

The proposed project aims to remove GHG from atmosphere by implementing sustainable grazing management practices along with few water management practices across over multiple grasslands of in Mexico. In the baseline scenario, ranchers in this region have traditionally followed practices such as continuous grazing, without any sustainable grazing management plans in place. This has resulted in overgrazing, leading to severe soil degradation and loss of vegetative cover. Loss of grasses due to continuous grazing in grassland ecosystems results in soil loss and erosion, soil carbon loss, reduced water filtration capacity, and reduced productivity of forage.

Through this project, ranchers are adopting new grassland management practices. These practices include rotational grazing and a variety of water conservation measures. In rotational grazing, livestock are rotated between different sections of a pasture over the course of days, weeks, or months, while other sections of the pasture are allowed to rest. These sections are known as “Paddocks”. This practice

allows plants to recover and grow in the paddocks that are allowed to rest, and thus allows them to sequester carbon, gradually regenerating the land. In addition, for arid regions like northern Mexico, water conservation measures help increase the availability of water (which would otherwise be lost) for the growth of the biomass, contributing to the regeneration. The livelihoods of the communities utilizing these ranches are improved directly through the carbon credit payments, which provide an additional source of income, and indirectly through the increased productivity of their lands. The regenerated lands also become much less likely to undergo land use change, because the ranchers are better able to sustain their livelihoods. This in turn ensures that crucial habitats for the flora and fauna of the region are protected. This results in the sequestration of greenhouse gases from the atmosphere to the soil.

The project has been designated as a 'Grouped Project' and plans to increase the number of project instances over a period of time. The first instance includes two major deserts – the Chihuahuan Desert and the Sonoran Desert. The Chihuahuan Desert spans 647,500 km² and the Sonoran Desert spans 260,000 km² across Northern Mexico and the Southwestern United States of America. All project parcels are in Mexico country.

The project start date is 4th September 2018, with a 20-year crediting period, until 3rd September 2038. With expected annual removals for 1st instance of this grouped project is approximately 1,233,480 tCO_{2e}/year on average, eventually the 1st instance of the project is estimated to remove about 24,669,598 tons CO_{2e} over the crediting period of 20 years.

This project also contributes to UN SDG goals 2, 6, 8, 13 and 15. The project also aims to develop livelihood options and improve socio-economic conditions of the local communities within the project area by providing jobs and training opportunities.

2 VALIDATION PROCESS

2.1 Method and Criteria

The project activity applies approved VCS methodology **VM0042 “Methodology for Improved Agricultural Land Management⁴”, Version 01** /27/, categorized under sectoral scope 14. This validation was undertaken as per VCS Standard v4.4, and its associated modules and tools as well as applying standard auditing techniques and Validation and Verification Manual v3.2.

The validation process is undertaken by validation team that involves the following:

- Contract review and appointment of audit team.
- Publication of VCS project design/description document

⁴ https://verra.org/wp-content/uploads/imported/methodologies/VM0042_Methodology-for-Improved-Agricultural-Land-Management_v1.0.pdf

- Completeness Check of the documents and templates used.
- The desk review of documents and evidence submitted by the PP in context of the reference VCS rules and guidelines. (Example: Project conformance to the applied methodology, including the procedure for the demonstration of additionality specified in the methodology)
- Design the sampling plan for audit.
- Undertaking site visit, interview, and interactions with the representative of the project proponent, project employees and local communities and other relevant stakeholders. The viewpoints collected in these interviews were considered by VVB along with onsite observation, objective evidence gathering, data production, and recorded analysis when reaching a validation opinion.
- To ensure the risk of auditing error is minimized to a reasonable level and ensure effectiveness & efficiency, a project specific validation and sampling plan was developed to guide the validation process. The methodology of the validation and sampling plan is based on the VCS guidance documents and ISO 14064-3:2019. Any modifications applied to the plan were made based upon the conditions observed for monitoring to detect the processes with highest risk of material discrepancy. The samples were observed and validated in selected sample plots through on-site assessment and satellite imageries analysis.
- Reporting audit findings with respect to clarifications and non-conformities and the closure of the findings, as appropriate.
- Preparation of final validation opinion.
- TR Comments and findings.
- Issuance of final validation report.

Sample Plan for audit

The sampling plan utilized the VCS guidance documents, ISO 14064-3 and the Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities Version 09.0. Random sampling was carried out considering a confidence interval of 95% and error of 10%. Specifically, sampling used to select grassland parcels to check their size and location, baseline practices and Right to Use and Enjoy of Land (land documents) and terms of references signed.

As per the table 2 of the Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities Version 09.0, acceptance sampling was conducted during the site visits.

For the determination of DOE's acceptance sample size, verification team assumed the following factors:

1. Producer risk -5% (ie, There is 5% chance that the DOE will wrongly reject the project participants' records of acceptable quality)
2. Consumer risk -10% (ie, There is 10% chance that the DOE will wrongly accept the project participants' records of records of unacceptable quality).

3. Acceptable quality level (AQL) or the Level of Assurance- 1% (i.e. the proportion of discrepancies between the project participants' sample records and the DOE sample that are acceptable up to 0.5% limit)
4. Unacceptable Quality Level (UQL) – 20% (ie, the proportion of discrepancies between the project participants' sample records and DOE sample records that are unacceptable above 20% limit)

Verification team has determined acceptance sample size for all the sample survey parameters based on the standard "Sampling and surveys for CDM project activities and programmes of activities".

From the above assumed factors, the verification team determined the minimum sample size (n) as 18 and acceptance number (c) as 1. The actual number of sample size where the acceptance survey was done given below:

Producers risk	Consumers risk	AQL	UQL	Sample size	Acceptance Number
5%	10%	1%	20%	18	1

Accordingly, the validation team conducted acceptance sampling of 18 ranchers in this validation process.

The sequence of the validation is given in the Table 1 below:

Table 1: Validation sequence

Topic	Date
Contract signed	18/03/2022
Site Visits	24/04/2022 to 30/04/2022
Draft Findings first round	05/05.2022
Draft Findings second round	07/06/2023
Final validation report for TR Comments	20/07/2023
Technical review on final reporting finalised	25/07/2023
Technical review Comments	31/07/2023
Final Corrections and Finalising the validation report for Verra submission	09/08/2023
Updated FVR	18/02/2025

Appointment of Validation Team: Based on a competence analysis and individual availabilities a validation team was appointed. Furthermore, also the personnel for the technical review and the final approval were determined.

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of VVB or outsourced entity)	Involvement in			
						Desk/document review	On-site inspection	Interviews	Verification findings
1.	Team Leader (Validator and Technical Expert)	IR	Puratchikkanal	Ma Paa	Central	X	X	X	X
2	Technical Expert (Models and remote sensing)	EI	Tiwari	Dr. Rakesh	External Expert	X		X	X
3	Local Expert	EI	Gonzalez	Dr. Francisco	External Expert	X	X	X	X

Technical reviewer and approver of the verification and certification report

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of VVB or outsourced entity)
1.	Expert to Technical Reviewer	EI	Hassan	Zainab	External Expert
2	Technical Reviewer	IR	S	Stalin	Central
3	Final Approver	IR	R	Chandrakala	Central

2.2 Document Review

The VCS Project Design (PD) submitted by PP was examined in light of the VCS Standard v4.4, along with additional background materials pertaining to the project design and baseline (such as the VCS Project Description Template, approved VCS methodology, and validation requirements).

Appendix 1 of this validation report has validation findings followed by document details that were examined during validation in “Reference” section of this document.

2.3 Interviews

Interviews with the PP, communities, and other pertinent stakeholders were conducted during the visit to the project area from 24/04/2022 to 30/04/2022. Before starting site visits, on 22 April 2022, a virtual meeting was held with PP and implementation partners. The individuals chosen for the interviews were based on their involvement in the project, their ability to affect its growth at the local or regional level, and their proximity to the project area. As a result, the interviewees included employees from PP and representatives from implementation organizations.

List of team members interviewed from Boomitra (PP) and implementation partner on ground.

SI No	Name of the person Interviewed	Affiliation	Date	Subject	Auditing Team Member
1	Aadit Moorthy	CEO of Boomitra	22/04/2022	Host Country rule and regulations related to project activity, Project description, Ownership, Project start date, Conditions prior to the Project initiation, Participation under other GHG programs, Non permanence risk analysis VCS PD, Excel Sheets, VER calculations, financials, Project Roles and Responsibilities allocated, Ownership and project details. Sampling and ecological survey points for data correction. Baseline emissions, computations, leakage and project emission assessments	Mr. Ma Paa Puratchikkanal Dr. Rakesh Tiwari, Dr. Francisco Gonzalez
2	Chethan T. R	Senior Manager, Boomitra	22/04/2022		
3	David Clark	Director of R&D, Geospatial	22/01/2023		
4	Dr. Cliserio Gonzalez	Director of Latin America, Boomitra	22/04/2022		
5	Josh Shaeffer	VP of Global Business Development, Boomitra	22/04/2022		
6	Rosario Alvarez Gutierrez	Pronatura Noreste AC, (Representative from Implementation partner)	22/04/2022		
7	Judith G.	Soluciones Ganaderas de Chihuahua SRLMI, (Representative from Implementation partner)	22/04/2022		

List of Ranchers interviewed

SI No	Name of the person Interviewed	Affiliation	Date	Subject	Auditing Team Member
1	La Nariz	Project participating rancher	24/04/2022	1. Project stakeholders, ranchers issues, community benefits, participation, extent of implementation,	Dr. Francisco Gonzalez And Dr Rakesh Tiwari (Virtual Interview)
2	El Chaparral				
3	Charco Azul				
4	Hermanos		25/04/2022		
5	Patitos				
6	Cerro Blanco				
7	Los Cascabeles		26/04/2022		
8	El Apache				
9	Las Víboras				

SI No	Name of the person interviewed	Affiliation	Date	Subject	Auditing Team Member
10	El Morrion			continued progress scenario.	
11	El Roble				
12	El Fresno				
13	La Laguna				
14	ENCINILLAS		27/04/2022	2. Training programs provided, Beneficiary requirements implementation, extent and future steps.	
15	San Ignacio		28/04/2022		
16	Las Palmas		29/04/2022		
17	Valle del Rosario				
18	San Luis		30/04/2022	3. Grievances and its addressal.	

2.4 Site Visits

The site visit was conducted on 24/04/2022 to 30/04/2022. The following tasks were undertaken during the site visit.

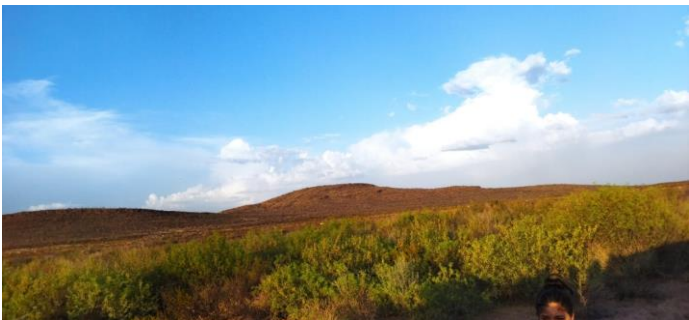
- To understand and evaluate the project area/boundary, project emissions and leakage management aspects if any.
- Validate baseline scenario and additionality of the project.
- Interviews with relevant personnel to confirm that the operational and data collection procedures are implemented in accordance with the Monitoring Plan.
- To validate all datasets provided are in line with the methodological requirements.
- To interact with the communities directly and indirectly dependent/impacting/impacted by the project and understand the socioeconomic dimension of the project.
- To understand the biodiversity dimension of the project.
- To check the project management, meet the management team, check the monitoring plan and its on ground implementation practices.
- To check the grassland area as defined and mentioned in the PD.
- Legal ownership of the lands.
- Review the financials audits and fund flow.
- Review the grievance mechanism in place.
- Verification of the effectiveness of the quality assurance and quality control methods.

The local expert first met the implementation partners on the ground, followed by a site inspection in the ranches. The project's activities, project boundaries, monitoring, responsible parties, and all other features were audited during the site visits.

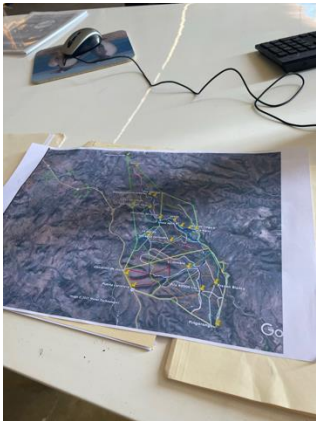
The following major questions were asked to all ranchers and ranching communities in the project area.

1. Who owns the land and how management activities are implemented.
2. Are ranchers aware about the carbon revenue sharing and carbon agreements with PP.
3. How did they receive trainings on sustainable grazing methods?
4. Do they see any benefits from sustainable grazing?
5. Are they aware about grievance mechanism for this project?

All responses were noted, and the audit team found that the ranchers do know about the Boomitra carbon project and carbon revenue sharing mechanisms. And all of them acknowledged that the sustainable grazing methods followed in this project have positive impacts on their soil.

Ranch Name	Images from Site Visit
Cerro Blanco	 

Ranch Name	Images from Site Visit
Charco Azul	 
Los Cascabeles	

Ranch Name	Images from Site Visit
	
El Roble	 
La Nariz	

Ranch Name	Images from Site Visit
	

During the site visits, our model expert had virtual interviews with the ranchers to check on the project activities and how they are implemented.

2.5 Resolution of Findings

In order to focus on high-risk concerns in the validation results without missing any of the required steps, 4KES uses a risk-based approach. During the validation, a few inconsistencies were discovered, and the validation report was sent to the project proponent with the titles corrective action requests (CARs) and clarification requests (CLs) attached.

CARs and CLs require the PP to take relevant actions. Criteria for judging items as CAR or CL are as follows:

Corrective action request (CAR): - The PP have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions - the Voluntary Carbon Standard's requirements have not been met, or - there is a risk that emission reductions cannot be monitored or calculated.

Clarification request (CL): - Information is insufficient or not sufficiently clear to determine whether the applicable VCS requirements have been met.

FARs: To draw attention to project implementation issues that need to be reviewed during the initial project activity verification, FARs will be raised. FARs have no bearing on VCS registration requirements.

Until this data is made available to the team leader's satisfaction, the validation process may be put on hold. Information or clarifications provided as a result of a CL may also lead to a CAR.

There was a total of 69 CARs, 15 CLs and 05 FARs raised during the validation process, all of which were successfully handled. The list of CARs/CLs raised, the response given, the method of validation, the

justifications for their closure, and references to correction in the pertinent documents are all included in this report's Appendix 2.

2.5.1 Forward Action Requests

The following FARs are raised during validation. Since the project involves a combination of process-based geochemical modelling and remote sensing, certain parameters need to be verified at the time of verification. Hence, a few FARs are raised that need to be addressed during the next audit.

Overall, five (05) FAR (s) has been raised during the validation and during VCS PRR review process FAR 04 and 05 has been added and FAR 02 has been closed. Refer Appendix 2 for the same.

3 VALIDATION FINDINGS

3.1 Project Details

3.1.1 Project type

The project corresponds to VCS sectoral scope 14 “Agriculture, Forestry and Other Land Use (AFOLU)”. The AFOLU project category is Agricultural Land Management (ALM). In the ALM category, the proposed project falls under the “Improved Grassland Management (IGM)”. The project is a grouped project.

3.1.2 Technologies and measures implemented.

The project activity is dedicated towards removal of GHG from atmosphere by implementing sustainable grazing management over multiple grasslands in the host country ‘Mexico’. There are improved grassland management activities in this project which sequester carbon from atmosphere and improve soil organic carbon in grasslands.

Validation checked both the activity descriptions and found these activities are in line with the methodological requirements. These activities will improve grasslands soil health. The validation team finds the information in sections 1.1 of the PD is consistent with the observation of audit team and outcome of the interviews with local communities and Project Proponent (PP) during the on-site visit.

CL 01 was raised and resolved successfully. Refer Appendix 2 for the same.

3.1.3 Eligibility of the project

The validation team reviewed the project design document in accordance with the VCS Standard v4.4 requirements and applied methodology. They confirmed the eligibility criteria outlined in sections 2 and 3 of the PD by cross-referencing with the specified requirements.

The VVB has validated the eligibility criteria (as mentioned in section 1.3 of the PD) and confirms that the project activities are in line with the following:

1. Project meets all the VCS standard v4.4 eligibility criteria requirements.
2. As per section 3.6.10 to 3.6.15 of the VCS Standard v4.4, the project meets the eligibility requirements of a grouped project.
3. The project has used a current and valid, approved, and up-to-date methodology to calculate its greenhouse gas emissions (GHG) reductions and removals in a conservative manner including the full application of any tools or modules referred to by a methodology as required by Section 3.1.1 & 3.1.2 of the VCS Standard, v4.4.
4. The project meets the additionality requirements as per the section 3.14 of VCS Standard v4.4.
5. The proposed project activities are in line with the methodological requirements which fall within the categories that demonstrably reduce net GHG emissions of grassland ecosystems by increasing soil carbon stocks (SOC).
6. The project activity has not cleared any native ecosystem or led to conversion of the native ecosystem, including conversion from the sand dune ecosystem within the 10-year period prior to the project start date. This has been validated through the evidence provided by the PP such as Satellite Imageries, Land title document, LULC analysis etc.

Please refer section 3.3.2 of this document to understand how the project adheres to the applicability conditions outlined in the employed methodology, VM0042. The audit team scrutinized the project activities, such as rotational grazing, and confirmed their alignment with the improved grassland management (IGM) activities category that demonstrably reduces net greenhouse gas (GHG) emissions in grassland systems by augmenting soil carbon stocks, as defined in Appendix 1 of the VCS Standard v4.4. The project proponent (PP) submitted baseline information collected through questionnaires from participating ranchers, who provided attestation on the questionnaire forms. Additionally, PP conducted telephonic interviews with the assistance of implementation partners to gather supplementary information related to baseline activities. The audit team verified these details, ensuring compliance with the methodological requirements specified in table 4 and Box 1 of the VM0042 methodology v1.

CAR 01 was raised and resolved successfully. Refer Appendix 2 for the same.

The validation team cross checked the eligibility criteria mentioned in the PD with respect to the following requirements and confirms the project activity conformance with VCS standard v4.4 and VM0042 v1.

- 1) The project has used the current and approved VM0042 methodology to calculate its greenhouse gas emissions (GHG) reductions and removals in a conservative manner including the full application of any tools or modules referred to by a methodology as required as per section 3.1.1 and 3.1.2 of VCS standard v4.4.
- 2) AFOLU specific requirements of Section 3.1 and Section 3.2 of the VCS Standard v4.4.
- 3) The project crediting period chosen is as per Section 3.9.3 of the VCS Standard, v4.4.
- 4) The Project has demonstrated its additionality requirements as set forth in section 3.14 of the VCS Standard, v4.4.
- 5) Baseline requirements against methodological requirements as mentioned in table 4 and Box 1 of the VM0042 methodology v1.

The audit team hereby confirms that this project has used a current and valid, approved, and up-to-date methodology to calculate its greenhouse gas emissions (GHG) reductions and removals in a conservative manner including the full application of any tools or modules referred to by a VM0042 methodology, v1 and VCS standard v4.4.

3.1.4 Project design, including eligibility criteria for grouped projects.

This is a grouped project and PP has demonstrated with proper justification for all the eligibility requirements. Also set out criteria for including new project instances.

A single methodology (VM0042, V1) has been used in this grouped project. Principle project activity is rotational grazing. At the time of validation, this grouped project has one project instance. In future new project instances will be added and PP has defined eligibility criteria for new instances, which meet the requirements of section 3.6.16 of VCS Standard V4. 4. Regarding eligibility criteria of grouped projects along with clauses mentioned in section 3.6.17 of the VCS Standard, V4.4 must be satisfied.

The audit team has analyzed the section 1.3 of the PD where PP has provided the explanation. The audit team reviewed project activities (ex: rotational grazing) implemented in this project and confirmed that they fall under the improved grassland management (IGM) activities category that demonstrably reduce net GHG emissions of cropland/grassland systems by increasing soil carbon stocks, as per the definition mentioned in Appendix 1 of the VCS Standard v4.4. It was established during the site visit that ranchers and implementation partner experts implemented the activities in this project. The audit team checked the baseline scenario with communities (Ejidos) and participating private ranchers and found that the unplanned continuous grazing was practiced extensively.

The audit team verified the polygons to ensure that no native ecosystems had been disturbed within the 10-year period prior to the project start date. PP has done a detailed LULC analysis of the lands enrolled in the project. Two sets of analysis have been done to check LULC variations among the participating ranchers. One set of analysis is done using MODIS/Terra Land Cover Types (500 m resolution) data. Because of its coarse spatial resolution and lack of data for a particular region at a particular time point, PP found some issues with classifying the grasslands. Hence, PP used GLAD Global Land Cover and Land Use Change dataset which has 30-m spatial resolution in such cases. Audit team verified the analyzed with high-resolution Google images and through other independent earth observatory sources. Hence audit team can conclude that the project grasslands are not cleared of native ecosystems within the 10-year period prior to the project start date.

Audit team verified the project activities with references provided by PP in the project description and found that the project activities implemented do not negatively impact or drain native ecosystems or degrade hydrological functions. This has been cross checked during the site visits interactions with the ranchers.

Since this project uses the combination of the RothC model and remote sensing to estimate emissions reductions/removals, PP has used the VMD0053, v1, tool in addition to the equation provided in the VM0042 methodology. The audit team checked the applicability conditions of both the VM0042 and

VMD0053 tool and it was confirmed that this project meets the applicability conditions set out in the methodology and tool applied to the project. PP provided the draft model validation report at the time of the PRR review stage. The audit team validated the draft model validation report /42/ and found the methods applied were in line with VMD0053 requirements. However, this model validation report is not final, and it will be finalized at the time of verification. Hence, FAR 01 and FAR 04 is still applicable. See section 3.3.2 of this document for more justification details.

PP has demonstrated all the requirements in section 1.4 of PD with adequate justifications and supports (such as cartographic and secondary information referenced in the joint PD/MR) about the compliance of the initial instances with the Eligibility Criteria of the grouped project set in the VCS Standard V4.4.

CL 02 and CAR 06, 11 was raised and resolved successfully. Refer Appendix 2 for the same.

3.1.5 Project proponent and other entities involved in the project.

There is only one project proponent “Boomitra Inc” in this project and all contact details are provided in section 1.5 of the PD. There are implementation partners in this project along with project proponent and the contact details of them provided in the section 1.6 of PD.

CAR 26, 69 was raised and resolved successfully. Refer Appendix 2 for the same.

3.1.6 Ownership

Boomitra Inc complies fully with Sections 3.7.1(1) of the VCS Standards v4.4 i.e "Project ownership arising or granted under statute, regulation or degree by a competent authority" and Section 3.6.1(4) "Project ownership arising by virtue of a statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions and/or removals".

The project ownership details are mentioned in section 1.7 of the PD and ownership proofs are provided by PP are validated. The validation team has confirmed this through interviews and legal ownership documents provided and is found to be in line with VCS requirements and National regulations and requirements. PP has made contracts with partners for 30 years to satisfy the conditions for longevity as per VCS requirements.

PP has provided carbon agreement /36/ signed by private individual rancher and community ranchers (Ejidos). These Ejidos are governed by government laws which mandates this group nominate a head/president known as Ejidial commissioner. PP has signed carbon agreement with all participating ranchers and the same has been checked and validated during the site visit.

PP is planning to include 625,000 hectares of land under the 1st instance of the project and at the time of validation 553,486.55 hectares have been onboarded and carbon credit agreements has been signed. And the remaining 71,000 ha is under final stages of signing the agreement and onboarding. As per VCS Standard V4.4, section 3.11.4, Boomitra’s control on total area is more than 80% (approximately <95%) of the total area planned in the 1st instance. During verification, the size of the project area will be fixed. However, PP has confirmed that this grouped project will onboard 2,700,000 hectares for this project under multiple instances during the crediting period.

The validation team has examined and evaluated the records of the lands. All property rights are acknowledged, protected, and supported; it is concluded. All of the properties engaged in the project have property titles and the necessary paperwork to prove and guarantee ownership of the land.

CAR 26, 69 was raised and resolved successfully. Refer Appendix 2 for the same.

3.1.7 Project start date

The start date of the project identified by PP is 04/09/2018. In line to the section 3.8 of VCS Standard v4.4/2/, the start of the project is the date which led to the generation of GHG emission reductions and removals. The start date in this project is a wages payment receipt for improved grazing activities on ranch such as digging of holes for fencing (creation of both permanent and temporary fences) and paddock demarcation (ranches identifying number of paddocks required based on livestock carrying capacity). PP has provided a supporting document for the start date i.e., invoice of purchase of fencing material in the preceding month of the start date. The project involves monitoring and managing of livestock in the grazing ranch along with other monitoring activities. A management plan/ 37/ has been developed to implement sustainable activities on ground by each ranch with the help implementation partner. The site visit interviews also confirmed the details the paddock creation activities.

PP confirmed that not all ranchers share same start date. Each ranch has different start dates and hence ER generation will depend on start date of the project activity for that ranch. Revised ERR sheet has accommodated this ERs calculated based on the start dates of the ranch.

Since the project involves combination of process-based geochemical modelling and remote sensing, the 'carbon stock measurement dates' are adjusted to satellite data availability to estimate SOC using AI and ML models.

CL 10 and CAR 02, 11 was raised and resolved successfully. Refer Appendix 2 for the same.

3.1.8 Project crediting period

The project crediting period is 20 years which starts on 4th September 2018 and ends on 3rd September 2038. Project longevity is 30 years.

3.1.9 Project scale and estimated GHG emission reductions or removals

The project fall under the 'Large Project' category since the annual average GHG emission reductions are **1,233,480 tCO₂** which is greater than 300,000 tCO₂e.

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
Year 2018*	Not applicable
Year 2019	1,275,037

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
Year 2020	999,661
Year 2021	1,398,426
Year 2022	1,270,186
Year 2023	1,232,893
Year 2024	1,232,893
Year 2025	1,232,893
Year 2026	1,232,893
Year 2027	1,232,893
Year 2028	1,232,893
Year 2029	1,232,893
Year 2030	1,232,893
Year 2031	1,232,893
Year 2032	1,232,893
Year 2033	1,232,893
Year 2034	1,232,893
Year 2035	1,232,893
Year 2036	1,232,893
Year 2037	1,232,893
Year 2038	1,232,893
Total estimated ERs	24,669,598
Total number of crediting years	20
Average annual ERs	1,233,480

*Note: It is to be noted that for the year 2018, as per equation 33 of the methodology, the initial SOC is the same in both the baseline and project scenarios at the outset of the project. As a result, carbon stocks in the soil organic carbon pool in the project scenario and baseline scenario are same and hence, there will be no reductions or removals.

3.1.10 Project location

The grouped project activity is expected to have expansion in the large grassland area (section 1.12 of PD) in the host country Mexico. The project area meets the eligibility criteria described in section 1.4 “Eligibility Criteria for Grouped Projects”.

The validation team crosschecked the references such as KML files for coordinates of the project area and found the details provided in the PD are correct. The VVB has ensured that the KML file and the project areas are revised to only contain grassland ecosystems and/or where areas livestock grazing has been conducted under the baseline scenario and where sustainable grazing is conducted in the project scenario. PP has removed the non-eligible areas such as roads, buildings, creeks/perennial rivers, water bodies, croplands, etc. from the project area in the revised KML file. Audit team has checked and found the KMLs are cleaned as per VCS 3.11.2 (3.c.i and 3.c.ii). PP has removed areas with dense biomass from the existing project area. PP submitted few images of the locations in which during the dry season where the vegetation looks much more sparse than other season when it is raining. Audit team checked the google images and found this situation is applicable in Mexico grassland region since the project location falls under desert grassland biomes characterized by semi-arid and arid climate, less rainfall, sparse vegetation, low biodiversity and very fragile natural conditions and resources^{5,6,7}. During the site visits, audit team also confirmed the similar situation by interviewing the rancher where they mentioned about the grazing situation of cattle in the grasslands. The ranchers confirmed that the ranchers divide the paddocks based on the area of grazing and don't eliminate any parcel of grasslands.



⁵ <https://jornada.nmsu.edu/files/bibliography/639.pdf>

⁶ <https://wrangle.org/ecotype/north-american-desert-grassland>

⁷ Hou, J., Du, L., Liu, K. et al. Characteristics of vegetation activity and its responses to climate change in desert/grassland biome transition zones in the last 30 years based on GIMMS3g. *Theor Appl Climatol* 136, 915–928 (2019). <https://doi.org/10.1007/s00704-018-2527-0>



Slope analysis of all the ranches has been conducted. Some ranchers do have elevated areas. After careful study of the management plans of these ranches, it was found that these are part of the paddock management systems. The PD has been revised, and the PP has clearly explained and demonstrated how the project activities will be implemented in remote and steep lands. The audit team has reviewed these updates and found them to be appropriate. During the site visit and interviews with the ranchers, the audit team also assessed the feasibility of implementing the project interventions in these challenging areas. The audit team assessment, which is based on the ground reality and the ranchers' experience, the implementation of these interventions is highly feasible and is a usual practice in the project area.

A detailed issue assessment and corresponding action points regarding the project area has been submitted as a separate document titled "KML Issues Action_Boomitra Grassland Project"/44/. The VVB has thoroughly checked the revised KML, PD, and ERR sheets and found the project area to be appropriate and in line with the requirements of Appendix A1.2. The revised ERR is correct.

CL 06 and CAR 11 was raised and resolved successfully. Refer Appendix 2 for the same.

During VCS review round 3 findings, VCS suggested the PP to demonstrate and provide evidence that areas with woody vegetation are used for grazing across all parts of the ranch, and if grazing occurs in all areas (including those with dense vegetation, semi-arid land with sparse vegetation, and areas with tree cover) the PP must ensure that relevant stratification and monitoring plans (e.g., by vegetation type, grassland/non-grassland, shrubland/trees) are in place for the purposes of SOC estimation in both the baseline and project scenarios. In response, the PP has provided detailed justification and supporting evidence showing that grazing is indeed practiced in these land-use scenarios. This has been validated and thoroughly explained in Section 3.3.4 of this report, as well as in Finding 7 of the PRR.

Additionally, VERRA asked PP to demonstrate that the project area is homogeneously used for grazing. If this is not the case, the project description must detail any variations in land cover. Additionally, if needed, the PP must implement stratification monitoring plans for accurate SOC estimation in both the baseline and project scenarios. In response, the PP submitted a report (Appendix 05 of the PD) documenting soil

carbon sequestration across different vegetation types in Northern Mexico ranches (4 ranches taken at this stage) and examining any potential variations across these strata. The ranches in Northern Mexico were first stratified into three different vegetation types: Semi-Arid (sparse vegetation), Dense Short Vegetation, and Tree Cover. This stratification was based on land use/land cover classifications from the Global Land Analysis and Discovery (GLAD) dataset, produced by a research group at the University of Maryland. The GLAD dataset is considered one of the most advanced high-resolution LULC datasets (0.00025 degrees lat/lon resolution, approximately 30m). Due to limited time and resources, the PP selected four ranches from the project that represent all strata well and performed calculations on them to assess SOC changes across the monitoring period (2018-2022) for each stratum. The results of this process are summarized for four example ranches in the table below:

Ranch Name	Stratum	Ranch Area Fraction	SOC% increase
San Felipe	Dense Short Vegetation	0.5663	0.205479765
	Semi-Arid	0.214	0.201837757
	Tree Cover	0.2197	0.038887251
El Candido	Dense Short Vegetation	0.4753	0.020907507
	Semi-Arid	0.4227	0.017882591
	Tree Cover	0.102	-0.007806952
El Pinito	Dense Short Vegetation	0.262	-0.216068588
	Semi-Arid	0.3352	-0.199018553
	Tree Cover	0.4029	-0.228044207
El Quelite	Dense Short Vegetation	0.633	0.044556261
	Semi-Arid	0.0652	0.025998279
	Tree Cover	0.3018	0.018557982

These ranches were especially selected for their significant diversity in vegetation strata. Most ranches in Northern Mexico do not have this level of diversity and are primarily dominated by one class.

From the above table it is clear that there are differences in sequestration rates between the strata, with tree cover seeing less sequestration rates over the monitoring period than the dense short vegetation. This analysis was thoroughly reviewed by the VVB, which validated the primary estimation methods and cross-checked the results using secondary literature.^{8,9}

PP also provided the explanation why ranch level pixel-based estimations are more accurate than the stratified level estimations due increased unknown errors resulting in stratification procedures. The calculation process of remote sensed soil organic carbon on the ranch level uses pixel-level data across the entire ranch, including all vegetation class. It captures data for every point, accounting for all variations across the landscape. Since all the data is used as-is, there's no need to group the area into different types (strata), reducing potential grouping errors. This is because of the greater errors introduced through the matching of pixels with strata that results in reduced accuracy in practice under the stratification approach. This reduced accuracy also increases the likelihood of a potential overestimation (and underestimation) of the carbon sequestration.

Theoretically and scientifically the justification provided by PP is acceptable.¹⁰

3.1.11 Conditions prior to project initiation

The condition prior to the project initiation is similar as explained in section 1.13 and 3.4 of the PD. In the baseline scenario, it is identified as unsustainable grazing practices that have led to grassland degradation to a large extent. The current “baseline” practice is continuous or otherwise unsustainable grazing, whereby animals repeatedly graze throughout a ranch in small groups, simply as a consequence of the most convenient and least time and energy demanding deployment of livestock. Section 1.13 of the PD also includes information on climate, hydrology, topography, demography, land use, soils, and vegetation of the project's zone in conformance with VCS PD Template v4.2, Section 1.13, and provides cartography information along with secondary literature evidence to support it.

The validation team crosschecked baseline scenario and related within Project area and found the details provided in the PD are correct. Based on the evidence provided and the discussion held with the project participants during the interview, it is clear that the continuation of the current and historical land use is the most likely scenario in the absence of the project activity.

CAR 06, 11 and CL 07, 08, 10 was raised and resolved successfully. Refer Appendix 2 for the same.

⁸ Scholes, R. J., & Archer, S. R. (1997). Tree-grass interactions in savannas. *Annual Review of Ecology and Systematics*, 28(1), 517-544 https://cales.arizona.edu/research/archer/publications/refereed_journal_articles/Scholes-Archer_1997_AnnRevEcoSys.pdf

Carbon sequestration potential of soils in southeast Germany derived from stable soil organic carbon saturation <https://onlinelibrary.wiley.com/doi/epdf/10.1111/gcb.12384>

Guo, L.B. and Gifford, R.M. (2002), Soil carbon stocks and land use change: a meta analysis. *Global Change Biology*, 8: 345-360. <https://doi.org/10.1046/j.1354-1013.2002.00486.x>

⁹ [Grasslands More Reliable Carbon Sink Than Trees | UC Davis](https://www.sciencedirect.com/science/article/pii/S0016706124001034)

¹⁰ <https://www.sciencedirect.com/science/article/pii/S0016706124001034>

The use of remote sensing in soil and terrain mapping — A review: <https://www.sciencedirect.com/science/article/abs/pii/S0016706110003976>

3.1.12 Project compliance with applicable laws, statutes and other regulatory frameworks

As per VCS standard, projects must follow the following rule. “Projects and the implementation of project activities shall not lead to the violation of any applicable law, regardless of whether or not that law is enforced.” Validation checked all the relevant laws of the country and found that project complies with this rule. There are no mandatory laws in the country which prevent the implementation of the proposed project activity.

The following laws are cross checked with evidence provided by the PP.

1. Article 4 of the Political Constitution of the United Mexican States, which says that any person has the right to a healthy environment for their development and well-being. Environmental damage and deterioration will generate a liability for whoever provokes them in terms of the provisions by the law (Universidad Nacional Autónoma de México. 2015. *Constitución reordenada y consolidada*. [online] Available at: <<https://www2.juridicas.unam.mx/constitucion-reordenada-consolidada/en/vigente>>).
2. General Law on Climate Change (2012): This law stipulates aligning activities on mitigation and adaptation between the different government entities. It sets certain emission reduction goals for the future to generate at least 35% of power with clean technologies by 2024 and to reduce emissions by 30% by 2020, and 50% by 2050 compared to 2000 (IEA. 2012. *General Law of Climate Change (Mexico)*. [online] Available at: <<https://www.iea.org/policies/8683-general-law-of-climate-change-mexico>>). This law also emphasizes adaptation measures to strengthen the resilience of natural and human systems. These measures aim to reduce social and environmental vulnerability.
3. The General Law of Ecological Balance and Environmental Protection (Ley General del Equilibrio Ecológico y Protección al Ambiente) (Ecology Law); the General Wildlife Law (Ley General de Vida Silvestre); and the Fisheries Law (Ley de Pesca) and the Regulation to the Fisheries Law (Reglamento de la Ley de Pesca). Recently Mexico repealed the Official Mexican Standard (Norma Oficial Mexicana (NOM)) NOM-059-ECOL-1994 and issued NOM-059-ECOL-2001. These laws and standards require that wild flora and fauna be broadly protected (Commission for Environmental Cooperation. 2022. *Summary of Environmental Law in Mexico*. [online] Available at: <<https://moose.cec.org/moose/lawdatabase/mxdoc.cfm?varlan=english&topic=17>>).
4. General Law for Sustainable Forest Development: this law promotes sustainable forest management to increase forest carbon stocks through active participation of vulnerable communities (Secretaría de Medio Ambiente y Recursos Naturales, Gobierno de México. 2018. *Ley General de Desarrollo Forestal Sustentable*. [online] Available at: <<https://www.gob.mx/semarnat/acciones-y-programas/ley-de-desarrollo-forestal-sustentable>>).
5. Development of projects on social property: Article 9 of the Agrarian Law states that ejidos own all real property granted to them as well as any property that they may have acquired title to by any other means. The same themes are also present in Section VII of Article 27 of the Constitution, which states that Ejidos “shall have legal capacity to enjoy common possession of the lands, forests, and waters belonging to them or which have been or may be restored to them”

- (Constitution of Mexico. [online] Available at: <https://web.oas.org/mla/en/Countries_Intro/en_mex-int-text-const.pdf>).
6. Convention on International Trade in Endangered Species of wild fauna and flora (CITES), 1973. Mexico is one of the parties that has signed this convention (Convention on International Trade in Endangered Species of Wild Fauna and Flora. 2022. *List of Contracting Parties*. [online] Available at: <<https://cites.org/eng/disc/parties/chronolo.php>>).
 7. Convention on Biological Diversity (CBD), 1992: The CBD's aims are the conservation of biodiversity, sustainable use of biological resources and equitable sharing of benefits arising from their sustainable use.
 8. Stockholm Declaration of the United Nations Conference in Human Environment (1972): Mexico is also one of the parties of this convention (Undocs.org. 1972. *United Nations Conference on the Human Environment: List of Participants*. [online] Available at: <<https://undocs.org/en/A/CONF.48/INF.5/rev.1>>). The Stockholm Declaration stipulates a person's right to freedom, adequate condition of life and responsibilities towards the environment and sustainable future of the planet.
 9. Human Rights: Mexico has ratified all international human rights treaties (UN Treaty Body Database. n.d. *Ratification Status for Mexico*. [online] Available at: <https://tbinternet.ohchr.org/_layouts/15/TreatyBodyExternal/Treaty.aspx?CountryID=112&Lang=EN> [Accessed 19 January 2022].)
 10. United Nations Declaration on the Rights of Indigenous Peoples: Mexico has voted in favor of this convention (Un.org. 2007. *GENERAL ASSEMBLY ADOPTS DECLARATION ON RIGHTS OF INDIGENOUS PEOPLES; 'MAJOR STEP FORWARD' TOWARDS HUMAN RIGHTS FOR ALL, SAYS PRESIDENT | Meetings Coverage and Press Releases*. [online] Available at: <<https://www.un.org/press/en/2007/ga10612.doc.htm>>).
 11. There are 81 International Labor Organization (ILO) conventions ratified by Mexico, out of which 68 are in force (International Labor Organization. 2022. *Ratifications of ILO conventions: Ratifications for Mexico*. [online] Available at: <https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:102764>). Mexico has ratified ILO convention 29 and 105 on elimination of forced and compulsory labor.
 12. Mexico, la Ley General de Consulta de los Pueblos y Comunidades y Afromexicanas (CECIG. 2021. *Ley General de Consulta de los Pueblos y Comunidades Indígenas y Afromexicanas*. http://cecig.org.mx/wp-content/uploads/2021/04/Minuta_Pueblos_Indigenas_Afromexicanas_Senado_22042021.pdf) mandates that local stakeholders from indigenous and Afro-Mexican communities be provided a very clear and communicative consultation for them to properly understand how any project impacts their communities.

Along with above laws, PP has documented the Mexico NDC commitments as well. Validation team finds that the project has a robust mechanism to identify each, and every parcel of land associated with the project to avoid any double counting of project carbon credits.

Therefore, it can be said that the project is carried out and complies with the relevant rules and regulations of the project area. As a result, it was determined that the project complies with VCS Standard V4.4 standards.

However, FAR 03 was raised for next audit. Since there is no Mexico's regulatory framework for carbon market. However, in future (before the verification) if the host country proposes a regulatory framework, then the PP is required to request an official letter from the Mexican government that allows the PP to develop the carbon project in the project area as well as trade Verified Carbon Units (VCUs) in the voluntary carbon market. Refer Appendix 2 for the same.

3.1.13 Participation under other GHG programs and Projects registered (or seeking registration) under other GHG programs Other forms of credit and supply chain (Scope 3) emissions":

The PP has submitted declarations /22/ to confirm that this project has neither been registered, or is seeking registration, under any other GHG programs nor rejected by any other GHG programs. The validation body has crosschecked the documents and declarations and found that the claim is in line with the VCS Standard v4.4.

CL 03 was raised and resolved successfully. Refer Appendix 2 for the same.

Scope 3 emissions declaration: As per VCS requirements, Boomitra has posted a public comment (<https://boomitra.com/projects/boomitra-grassland-restoration-in-northern-mexico/>) saying VCUs may be issued for the greenhouse gas emission reductions and removals associated with its projects on the website.

However, FAR 03 was raised for next audit. Since there is no Mexico's regulatory framework for carbon market. However, in future (before the verification) if the host country proposes a regulatory framework, then the PP is required to request an official letter from the Mexican government that allows the PP to develop the carbon project in the project area as well as trade Verified Carbon Units (VCUs) in the voluntary carbon market. Refer Appendix 2 for the same.

3.1.14 Emissions trading programs and other binding limits and Other forms of environmental credit sought or received and eligible to be sought or received

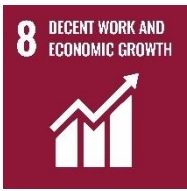
PP has clearly mentioned that the project will not seek to generate or has received any form of environmental credits, and the GHG emission removals generated by the project will not be used for compliance under such programs or mechanisms.

PP has submitted undertaking for the same /22/.

CL 03 was raised and resolved successfully. Refer Appendix 2 for the same.

3.1.15 Sustainable development contributions

The project contributes to sustainable development through sustainable grazing management practices. Through these activities, jobs are created, and local people are empowered since they are involved in implementation and monitoring of the project. PP has described contribution of project to SDG goals 2, 6, 8, 13 and 15 in the section 1.17 of PD.

SDG Goal	Chosen Parameter PP	Project Impact described by PP	VVB Justification
	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.	The project activity improves soil quality by increasing Soil Organic Carbon (SOC). Higher SOC content leads to better productivity and improved soil fertility, making agricultural production more climate resilient.	Justification provided PP is satisfactory and audit find that this SDG goal selection is correct for this project.
	6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	Increases in soil organic matter improve soil aggregates and structural stability, which help water infiltration into the soil by increasing soil aeration. This reduces excess runoff.	Justification provided PP is satisfactory and audit find that this SDG goal selection is correct for this project.
	8.6 By 2020, substantially reduce the proportion of youth not in employment, education or training	The project provides employment to local communities during the implementation and monitoring process	Justification provided PP is satisfactory and audit team evaluated the employment records /35/ on ground

SDG Goal	Chosen Parameter PP	Project Impact described by PP	VVB Justification
			and team finds that this SDG goal selection is correct for this project.
	13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	The project promotes sustainable grassland management practices in the project area, thereby removing CO ₂ from the atmosphere.	Justification provided PP is satisfactory and audit find that this SDG goal selection is correct for this project.
	15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	Through rotational grazing practices, vegetation is allowed to grow and stay on the ground for more time, thereby allowing for degraded grasslands to be gradually restored, and reversing desertification.	Justification provided PP is satisfactory and audit find that this SDG goal selection is correct for this project.

All the activities mentioned in PD are in line with the Mexico NDC, which has a specific topic for the AFOLU sectors. Audit team cross checked Mexico's national strategy to achieve all 17 SDG goals which has a long-term vision that aims to guide the actions of the state, civil society and private-sector actors. Mexico has developed a framework (UN Sustainable Development Cooperation Framework of Mexico 2020-2025 (UNSDCF)) in which it has identified four thematic areas that contribute to SDGs (Angelino, D., 2021. *MEXICO PARTNERSHIP LANDSCAPE ASSESSMENT*. [ebook] United Nations. Available at: <<https://sdgs.un.org/sites/default/files/2021-09/Mexico%20Partnership%20Landscape%20reduced.pdf>>). PP also mentioned the monitoring mechanism/plan to evaluate above mentioned SDG goals during crediting period.

The validation team finds the information in sections 1.17 of the PD is consistent with the observation of audit team and outcome of the interviews with local communities and PP during the site visit and also validation team concludes that the proponent demonstrates how the project activities, or additional activities implemented by the project proponent, contribute to sustainable development.

However, FAR 03 was raised for next audit. Since there is no Mexico's regulatory framework for carbon market. However, in future (before the verification) if the host country proposes a regulatory framework, then the PP is required to request an official letter from the Mexican government that allows the PP to develop the carbon project in the project area as well as trade Verified Carbon Units (VCUs) in the voluntary carbon market. Refer Appendix 2 for the same.

3.1.16 Leakage management for AFOLU projects

PP has identified two leakage forms they are livestock displacement leakage and Market Leakage. PP has provided enough justification in Section 1.18 why the identified leakages are negligible.

PP has also confirmed that ranchers may sell the cattle for beef industry where the cattle are consumed as food. This will not result in displacement of livestock from the project boundary. The drastic drop in the livestock stocking rates might happen when there is a severe drought/ lack of forage in the region. Hence, the likelihood of displacement of cattle from the project boundary is very negligible. PP also confirmed that the ranchers do not use any additional manure to increase the soil fertility in the grasslands. PP has confirmed that none of the project activities will impact the productivity (i.e, forage availability and/or livestock stocking rates) within the project boundary. Validation team also verified the sources (literature, reference papers etc.) for the same and the justification provided by the PP was satisfactory. However, PP has also stated in the PD that, as required by the methodology, the productivity will be measured every ten years and changes in productivity will be quantified as per Eq 29 or Eq 30 in the methodology.

3.1.17 Commercially sensitive information

Details of ranch ownership and financial audit plans are removed from the public version of this document to protect landowner privacy.

The description given by PP in Section 1 of the PD is true to form, comprehensive, and gives insight into the scope of the project. Additionally, the validation team certifies that all activities detailed in the PD are supported by data from the project design document.

3.1.18 Participation under Other GHG Programs

The VCS PD– section 1.15 makes it clear that the project does not participate under other GHG program and has not been rejected by any other GHG program.

Boomitra Grassland Restoration in Northern Mexico complies with the validation criteria for projects set out in VCS Version 4.4. 4K Earth Science has reviewed the project description documents for its accuracy and completeness check and whether it provides an understanding of the nature of the project and subsequently VVB team carried out site visit interviews to confirm the fulfilment of stated criteria.

3.2 Safeguards

3.2.1 No Net Harm

As discussed in section 2.1 of the PD, the project does not expect any negative environmental impacts. The project activity i.e., planned grazing and water management activities will increase SOC in the grasslands.

Rotational grazing and water management activities do not have negative impacts on the environment. Rotational grazing methods implemented by fencing with more rotations allow the recovery of grasses, which foster greater carbon inputs, higher retention of carbon as lignin and cellulose, and greater belowground production. This results in the sequestration of greenhouse gases from the atmosphere to the soil. Further, there will be positive impacts on biodiversity conservation through the preservation of critical habitats of the endemic and endangered flora and fauna. There is no negative impacts on community groups and for maintenance or enhancement of HCV attributes related to community well-being. Audit team checked section 1.11 of the PD and found none of the project activities promote noninvasive species and also fertilizer application along with biological agents, and other kinds of inputs. Hence audit team confirms that there is no introduction of invasive species and non-native species in the project area. There is no promotion of use of fertilizers, chemicals, biological agents and other kinds of inputs in the ranches of the project area.

The Validation team came to the conclusion that project activities had no adverse effects on the environment or the community after visiting the project site and speaking with local stakeholders and PP. The validation body determines that it will have a good impact on society, the environment, and biodiversity; as a result, it complies with section 3.18.1 of the VCS Standard v4.4.

3.2.2 Local Stakeholder Consultation

This is explained in section 2.5 of the validated PD. The PP carried out the consultations with the stakeholders on 31st January 2022 using virtual meeting (details are available in Appendix 1 of PD) along with regular interaction which is ongoing. The minutes of meetings, attendance sheets and photographs of the consultations with the comments from stakeholders were provided to the VVB. The comments raised during the consultations were addressed by the PP. All the stakeholders interviewed during the site visit gave positive responses about the project. While checking all the reports, minutes of meetings, questionnaire responses during the site visit, it is confirmed that all the stakeholders agreed to the implementation of the project.

Section 2.2 PD and Appendix 1 of PD has the complete information of the consultations held for this project. All the details about the project activities, expenses, potential costs of the implementation, risks and benefits associated with them are discussed. During site visit, validation team cross checked the documentation provided by the PP with local people and found satisfactory. PP has set up grievance mechanisms to address stakeholders' issues about this project. During the site inspection, all of the stakeholders who were questioned expressed support for the project. While checking all documents and proofs provided and interviews conducted during site visit, it is confirmed that all the stakeholders agreed

to the implementation of the project and are very optimistic for the initiative and the project adhere to the requirements of section 3.18.3 VCS Standard v4.4. To maintain ongoing communication with local stakeholders, Boomitra has devised a mechanism where all stakeholders can express their concerns through grievance mechanisms, which are discussed in Section 2.5 of PD. PP has developed a proper multi-level grievance addressal model to handle any grievances arising during the project cycle. This is one of the key requirements to be met as per global standards. These grievance addressal mechanisms are discussed in all stakeholder consultations and made available to all relevant stakeholders in the project area. Physical register (Grievance Expression Process Book) /32/ has been maintained at each implementation partner head office and this has been checked during the site visits.

CAR04 was raised and resolved successfully. Refer Appendix 2 for the same.

3.2.3 Environmental Impact

Validation team checked the country requirements on EIA rules and regulations act Environmental Impact.

The Mexican Secretariat of Environment and Natural Resources (SEMARNAT) is the regulatory and competent authority that handles Environmental Impact Assessment (EIA) of a project and issues permits. The Mexican General Ecological Balance and Environmental Protection Law (Ley General Del Equilibrio Ecologico y La Proteccion al Ambiente) gives a list and types of projects that need to undergo an environmental impact assessment (EIA) (*GENERAL LAW OF ECOLOGICAL BALANCE AND ENVIRONMENTAL PROTECTION*, Mexico. Available at: <<https://www.global-regulation.com/translation/mexico/560296/general-law-of-ecological-balance-and-environmental-protection.html>>). Article 28 of this law has a list of activities required to undergo the EIA process from the competent authority. The proposed project does not require an EIA.

Hence the Validation team finds the information in sections 2.3 of the PD is consistent with the observation of audit team and outcome of the interviews with local communities and PP during the site visit.

3.2.4 Public Comments

The project documentation has been published on VCS website and was open for public comment from 25/03/2022 to 24/04/2022 (<https://registry.verra.org/app/projectDetail/VCS/2887>). No comments received as evident from the VCS pipeline in the web interface.

CL04 was raised and resolved successfully. Refer Appendix 2 for the same.

3.2.5 AFOLU-Specific Safeguards

Section 2.5 of PD has information on stakeholder identification and its results. PP has identified the potential risks associated with the project and designed the mitigation plan for the same. These risks associated with the project on stakeholder property rights or in any other form of risk have been discussed during the stakeholders meeting. Also, PP has appointed a staff member to record and collect conflicts and dissatisfaction between local communities and individual ranch owner and PP has set up a Grievance

register to record any grievances. Copy of the register has been validated during the site visit. Validation team has crosschecked all the information provided in PD along with evidences and finds no deviations associated with safeguards.

3.3 Application of Methodology

3.3.1 Title and Reference

The project has applied VCS approved VM0042 “Improved Agricultural Land Management” , Version 1.0 (https://verra.org/wp-content/uploads/imported/methodologies/VM0042_Methodology-for-Improved-Agricultural-Land-Management_v1.0.pdf) methodology along with following tools.

Tools:

1. AFOLU Non-Permanence Risk Tool to estimate buffer credits as per VCS standard requirement ((dated 19th September 2019, version 4.0):/05/.
2. VMD 0053 Module: Model calibration, validation, and uncertainty guidance for the methodology for improved agricultural land management /21/ (dated 19th October 2020, version 01)

PP has used VM0042 version 2 (under development) methodology during the first submission of the documents to the VVB for validation. The audit team has raised a few CARs with respect to underdevelopment methodology. Based on the CARs, PP had written an email to VCS to get more clarity on the methodology used for this project. However, VCS has replied, saying that the validation cannot be complete until an approved new version has been released by VCS. In the month of May 2023, a new methodology was released, and PP has found that using remote sensing is not allowed. Hence, PP reverted back to the older version of the methodology (i.e., 01, where VCS allowed Projects that have already requested listing on the Verra Registry before 30 May 2023 may complete validation using the previous version of VM0042 and VMD0053 within six months), which allows remote sensing technology to estimate certain parameters, and changed the quantification approach to Approach 1 of the methodology.

The validation team confirms that the methodology and tools, and the specific versions of them applied by the project, were valid at the time of validation.

3.3.2 Applicability

The project complies with each applicability condition of the methodology and associated modules and tools. The same has been justified in the below section.

The project activity complies with the applicability conditions of the VCS VM0042 methodology Version 1 as follows:

Applicability Condition	Justification	VVB assessment
Projects must introduce or implement one or more new changes to pre-existing	The project activities are new activities implemented by the landowners relative to the baseline scenario. The current baseline	Description of project activity section of PD has listed improved grazing management activities

Applicability Condition	Justification	VVB assessment
agricultural management practices Which • Reduce fertilizer (organic or inorganic) application. • Improve water management/irrigation. • Reduce tillage/improve residue management. • Improve crop planting and harvesting (e.g., improved agroforestry, crop rotations, cover crops); and/or • Improve grazing management.	scenario is continuous unsustainable grazing on community-owned or privately-owned grasslands. The proposed project activity introduces and expands new sustainable improved grassland management practices such as rotational grazing on subdivisions of ranches known as paddocks.	along with implementation plan. Validation team checked during site visits and interviewed people to assess project activity and found accurate.
Project activities must be implemented on land that is either cropland or grassland at the project start date and remains cropland or grassland throughout the project crediting period (i.e., land use change is not eligible, including conversion from cropland to grassland and grassland to cropland).	The project is implemented on grasslands. The land has remained grassland prior to the project and after the start of the project. This is the natural state of the land, which has been verified by satellite images over the past 10 years (provided separately in a folder named Ranch_landsat_images_2007-2021) Detailed LULC analysis of each participating grassland has been carried out. Analysis of these satellite images and LULC confirms that these lands have remained grasslands and are not converted or cleared of any native ecosystems.	Validation team cross checked the land documents and LULC analysis of the polygons. Audit team found the information provided is correct. Two sets of analysis has been done by PP to check LULC variations among the participation ranchers. One set of analysis is done using MODIS/Terra Land Cover Types (500 m resolution) data. Because of its coarse spatial resolution and lack of data for particular region for particular time point, PP found some issues with classifying the ranchers. Hence PP used GLAD Global Land Cover and Land Use Change dataset which has 30-m spatial resolution PP
The project area must not have been cleared of native ecosystems within the 10-year period prior to the project start date.		

Applicability Condition	Justification	VVB assessment
		could find that all the project participant ranches remained grasslands. Audit team cross checked the datasets and found that the analysis is correct and satisfactory.
The project activity is not expected to result in a sustained reduction of greater than 5% in productivity, as demonstrated by peer-reviewed and/or published studies on the activity in the region or a comparable region.	Literature on rotational grazing has been developed for several decades and does not suggest any significant changes to productivity. During the interactions with the ranchers, we have received the same opinion on productivity. There are various studies conducted at different grasslands and suggests that productivity and sustainability may be compatible by replacing continuous with rotational grazing. (Jacobo, Elizabeth & Rodríguez, Adriana & Bartoloni, Norberto & Deregibus, Victor. (2006). Rotational Grazing Effects on Rangeland Vegetation at a Farm Scale. Rangelands. 59. 10.2458/azu_jrm_v59i3_jacobo. (http://dx.doi.org/10.2458/azu_jrm_v59i3_jacobo) This will be confirmed during the verification stage with proper studies.	Justification provided PP is satisfactory and audit team cross checked the secondary literature information and found satisfactory.
If the project activity involves the application of biochar, it must be produced using feedstock that would otherwise have been left to decay in aerobic or anaerobic conditions or been burned in an uncontrolled manner. Eligible feedstocks include one or more of the following categories of biomass: • Crop residues; • Material from	This is not applicable for this project since no project activity promotes biochar as a soil amendment.	During site visits, audit team cross checked and found this conditions is not applicable and hence justification by PP is satisfactory.

Applicability Condition	Justification	VVB assessment
pruning or thinning of woody vegetation (not including merchantable timber) in agricultural systems such as shade trees, orchards, windbreaks, stream buffers, silvopasture, or invasive removal on rangeland; • Off-cuts, sawdust, and other material produced as a by-product of forest management or harvesting operations; • Diseased trees or deadwood felled during plantation or woodland management; and/or • Residential, commercial, or industrial organic food or yard waste. There may not be any other carbon incentive awarded for the production of biochar applied on the project area.		
The project activity cannot occur on a wetland. Note that this condition does not exclude crops subject to artificial flooding where it can be demonstrated that crop cultivation does not impact the hydrology of any nearby wetlands.	The project area is not a wetland. The project is implemented on grasslands. The land has remained a grassland prior to the project and will remain the same after the start of the project. It is an arid land as noted in Section 1.13	There are no wet lands in this project as per the KMLS provided by the PP at the time of validation. Hence the conditions is met.

Since this project uses the combination of process based RothC model and remote sensing technology, the following conditions are evaluated.

1. Is this model publicly available?

Yes, RothC is publicly available and fully documented at the Rothamsted Research website¹¹.

2. **Shown in peer-reviewed scientific studies to successfully simulate changes in soil organic carbon and trace gas emissions resulting from changes in agricultural management included in the project description.**

RothC has been shown to be applicable in grasslands around the world, for various management conditions including continuous grazing^{12,13}, and rotational grazing^{14,15}.

3. **Able to support repetition of the project model simulations. This includes clear versioning of the model use in the project, stable software support of that version, as well as fully reported sources and values for all parameters used with the project version of the model. Where multiple sets of parameter values are used in the project, full reporting includes clearly identifying the sources of varying parameter sets as well as how they were applied to estimate stock change/emissions in the project. Acceptable sources include peer-reviewed literature and statements from appropriate expert groups (i.e., that can demonstrate evidence of expertise with the model via authorship on peer-reviewed model publications or authorship of reports for entities supporting climate smart agriculture, such as FAO or a comparable organization), and must describe the data sets and statistical processes used to set parameter values (i.e., the parameterization or calibration procedure).**

RothC 26.3, the most widely available and used version, is used for all calculations. Specific calibration methods to determine parameters for each Practice effective/Crop Functional Group in each climate zone are determined using field trial data from peer-reviewed literature, and these details will be provided in the latest model validation report at the time of each verification.

4. **Validated per datasets and procedures detailed in VMD0053 “Model Calibration and Validation Guidance for the Methodology for Improved Agricultural Land Management”, with model prediction error calculated using datasets as detailed in the same module, using the same parameters or sets of parameters applied to estimate stock change/emissions in the project**

The Model Validation Report will provide the validation methods and prediction error quantification, as detailed in VMD0053 at the time of each verification.

11 Rothamsted Carbon Model (rothc). Rothamsted Research. <https://www.rothamsted.ac.uk/rothamsted-carbon-model-rothc>

12 Smith, S. W., Vandenberghe, C., Hastings, A., Johnson, D., Pakeman, R. J., Wal, R. van der, & Woodin, S. J. (2013, December 6). Optimizing carbon storage within a spatially heterogeneous upland grassland through sheep grazing management - ecosystems. SpringerLink. <https://link.springer.com/article/10.1007/s10021-013-9731-7>

13 Jebari, A., Álvaro-Fuentes, J., Pardo, G., Almagro, M., & Prado, A. del. (n.d.). Estimating soil organic carbon changes in managed temperate moist grasslands with Rothc. PLOS ONE.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0256219>

14 Bolinder, M. A., Chan, K. Y., Farage, P. K., Janssen, P. H. M., Jeffrey, S. J., Kemmitt, S. J., Lal, R., Lima, A. M. N., Liu, D. L., Moore, A. D., Paul, K. I., Smith, P., Bertora, C., Brumme, R., Chen, G., & Coleman, K. (2011, August 4). Simulation of soil organic carbon dynamics under different pasture managements using the ROTHC carbon model. Geoderma.

<https://www.sciencedirect.com/science/article/pii/S0016706111001947>

15 Poeplau, C. (2016, August 24). Estimating root: Shoot ratio and soil carbon inputs in temperate grasslands with the ROTHC model - plant and Soil. SpringerLink. <https://link.springer.com/article/10.1007/s11104-016-3017-8>

From the above audit assessment, it was concluded that the project is in line with the applied methodology and tools. PP has included all supporting documentation and provided adequate justification to confirm compliance with the conditions, as is described in relevant sections of PD.

CAR 01, 05, 06, 07, 11, 29, 36 and CL 15 was raised and resolved successfully. Refer Appendix 2 for the same.

3.3.3 Project Boundary

This is a grouped project located in Mexico At the time of validation there is one instance. Details are as follows.

Instance 1:

Project Area: Aguascalientes, Baja California, Baja California Sur, Chihuahua, Coahuila, Durango, Guanajuato, Nuevo Leon, San Luis Potosi, Sinaloa, Sonora, Tamaulipas, Zacatecas states in Mexico country.

The first instance of this grouped project area covers an area of approximately 575,515.16 hectares at the time of validation for instance 01. Total area 2,700,000 hectares are planned by PP in this grouped project.

State	Longitude (W)	Latitude (N)
Aguascalientes	102°52'26.40" W 101°50'06.00" W	21°37'20.28" N 22°27'34.56" N
Baja California	118°21'54.00" W 112°17'49.20" W	28°00'00.00" N 32°43'07.32" N
Baja California Sur	115°13'26.40" W 109°24'46.80" W	22°52'19.20" N 28°00'00.00" N
Chihuahua	109°04'30.00" W 103°18'25.20" W	25°33'31.68" N 31°47'04.20" N
Coahuila	103°57'36.00" W 99°50'35.16" W	24°32'33.72" N 29°52'48.00" N
Durango	107°12'36.00" W 102°28'22.80" W	22°20'42.36" N 26°50'41.64" N
Guanajuato	102°05'49.20" W 99°40'16.68" W	19°54'46.08" N 21°50'21.84" N
Nuevo Leon	101°12'25.20" W 98°25'17.76" W	23°09'45.72" N 27°47'56.76" N
San Luis Potosi	102°17'45.60" W 98°19'33.60" W	21°09'36.72" N 24°29'29.40" N
Sinaloa	109°26'52.80" W 105°23'31.20" W	22°28'01.56" N 27°02'32.28" N
Sonora	115°03'10.80" W 108°25'26.40" W	26°17'49.20" N 32°29'38.04" N
Tamaulipas.	100°08'42.00" W 97°08'39.12" W	22°12'25.20" N 27°40'44.76" N
Zacatecas	104°21'14.40" W 100°44'30" W	21°02'30.84" N 25°07'30.72" N

PP has updated the maps and the same has been updated in the validation report.

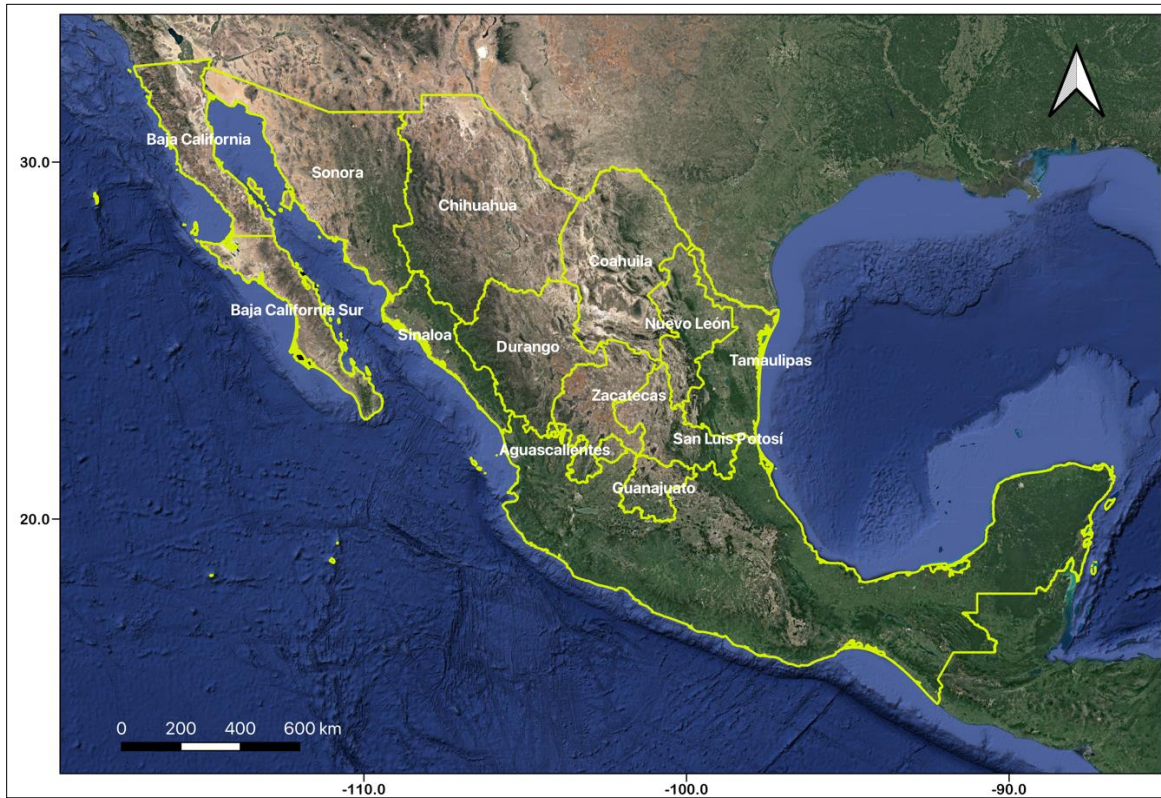


Figure 1: Grouped Project location Map

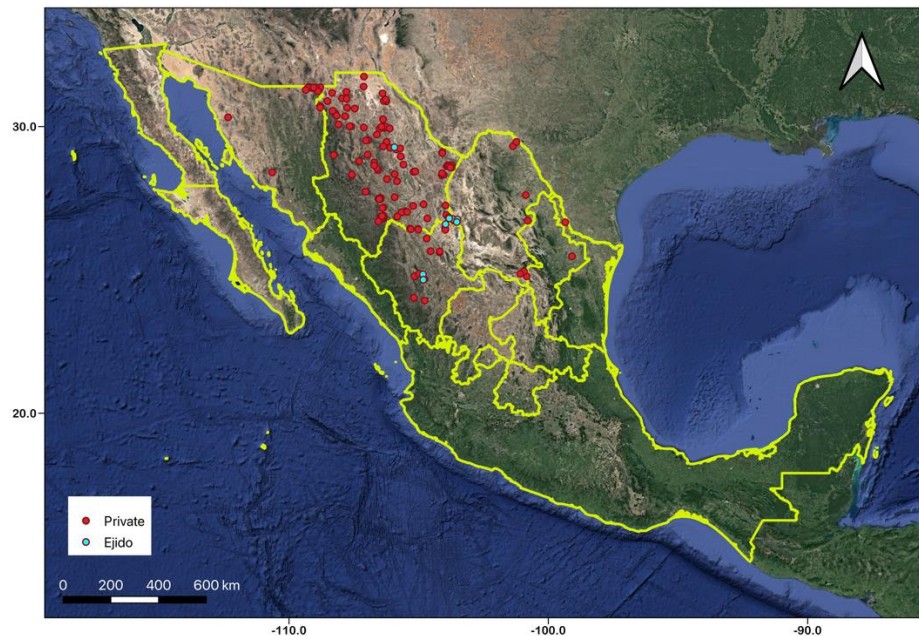


Figure 2: Instance 01 private and Ejido rancher locations

The Carbon Pools and GHG sources included in the Project are mentioned in the table below:

Carbon Pool	Included?	Justification/ Explanation of Choice
Aboveground tree biomass	No	None of the project activities promoting any activities which increase woody biomass. Due to rotational grazing, biomass of grass does increase and noted here as 'herbage dry matter'. (See the reference: https://www.sciencedirect.com/science/article/pii/S0167880922002249). Hence, the above ground biomass is not included in the carbon pool in the project.
Aboveground non-tree biomass	No	As per VCS rules this has been excluded. (VM0042, table 2)
Belowground biomass	No	Project does not involve any activity which contributes to belowground tree biomass and there is no provision set aside to monitor this parameter
Dead wood	No	As per VCS rules, this has been excluded. (VM0042, table 2)
Litter	No	As per VCS rules, this has been excluded. (VM0042, table 2)
Soil Organic Carbon	Yes	Included as per VCS AFOLU Requirements as the landcover under the baseline scenario is comprised of grasslands. The proposed project activity increases this pool in the project scenario.
Wood Products	No	As per VCS rules, this has been excluded. (VM0042, table 2)

The GHG sources project boundary is outlined in the following table.

	Source	Gas	Included?	Justification/Explanation
Baseline	Soil Organic Carbon	CO ₂	Yes	Primary stock changing due to rotational grazing and other project activities
Project	Soil Organic Carbon	CO ₂	Yes	Primary stock changing due to rotational grazing and other project activities

Project activities are taking place throughout the project area, and primarily affect soil organic carbon. All other stock or pool changes are deemed de minimis relative to the total net anthropogenic GHG reductions and removals by PP. Insignificant emission sources are excluded according to the VCS rules by PP.

All other GHG sources (CH₄ and N₂O) have been excluded from the project boundary since none of the project activity involves impacting these sources. As per methodology (section 5), Where the increase in

greenhouse gas emissions from any project emissions or leakage source, and/or decreases in carbon stocks in carbon pools, is less than five percent of the total net anthropogenic GHG emission reductions and removals due to the project, such sources and pools may be deemed de minimis and may be ignored (i.e., their value may be accounted as zero). This needs to be assessed in the verification stage using the tool (CDM A/R methodological Tool) specified in VM0042 methodology.

By checking the information and evidence available during on-site observation and by the supporting documents submitted by the PP, the audit team concluded that the appropriate carbon pools and GHG emissions sources have been considered and the description in the PD is accurate and complete, and also the selected carbon pools are justified for the proposed project activity.

CL 06, 13 was raised and resolved successfully. Refer Appendix 2 for the same

3.3.4 Baseline Scenario

As per the methodology, *“For each sample unit, a schedule of activities in the baseline scenario will be determined by assessment of practices implemented during the period prior to the project start date. The interval over which practices are assessed, x years, must be a minimum of 3 years and include at least one complete crop rotation, where applicable. Where a crop rotation is not implemented in the baseline, x = 3 years”.*

The baseline scenario is identified by PP as unsustainable grazing practices that have led to grassland degradation to a large extent. The current “baseline” practice is continuous or otherwise unsustainable grazing, whereby animals repeatedly graze throughout a ranch in small groups, simply as a consequence of the most convenient and least time and energy demanding deployment of livestock. This is substantiated by the lack of significant local knowledge on rotational grazing prior to its introduction by ground partners, and the general history of the land use over the past few centuries. Overgrazing over the course of this period of time has changed the grassland composition in the project area – resulting in the promotion of invasive species at the expense of native perennial grasses that are preferably eaten by livestock. In the absence of this project activity, ranchers will continue unsustainable grazing, which further degrades grasslands.

PP has used historical data to prove that the land area included in the project remained grasslands and still the lands are grasslands, but these lands have degraded. The below image shows the consequences of unsustainable grazing practices that have led to land and soil degradation.

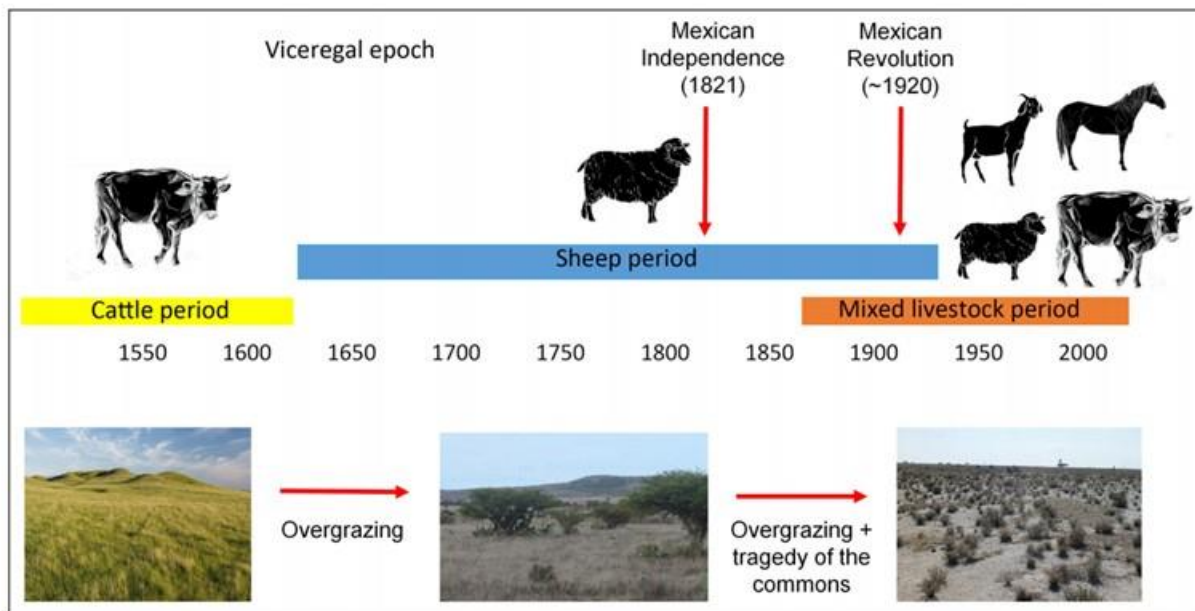


Figure 3: Livestock ranching on grasslands in the southern part of the Mexican Plateau

The project is being implemented in Northern Mexico is covered by vast arid regions and 2 major deserts – the Chihuahuan Desert and the Sonoran Desert. The Chihuahuan Desert spans 647,500 km² across Northern Mexico and the Southwestern United States of America. It is the largest desert in North America, covering the states of Chihuahua, Coahuila, Durango, Zacatecas, Nuevo León, and San Luis Potosí in Mexico and Arizona, New Mexico and Texas in the United States of America. Furthermore, the Chihuahua Desert holds a unique position among deserts in the Americas from other perspectives: it receives much more rain, a necessity for building biomass and enabling carbon sequestration, than nearby deserts such as the Sonoran and Mojave deserts. Another side-effect of this increased precipitation is enhanced biodiversity. The Chihuahua desert is considered among the world's most biodiverse arid regions, with a significant presence of unique flora and fauna, including one-fourth of the world's cactus species, 170+ reptile and amphibian species, 130+ mammal species and 400+ bird species. PP has quoted various secondary literature to show that these lands are degraded due to unsustainable practices in the baseline scenario. There is one more baseline condition, which is the conversion of grasslands to croplands. In the absence of the project, these grasslands are bound to become croplands. During site visits, the validation team cross-checked with local communities, and they also noticed the claim made by PP.

The baseline SOC decline (accumulation) rates from literature ($-0.69 \text{ tCO}_2/\text{acre}/\text{year}$) /8/, albeit scarce, looks reasonable. However, the PP is advised (FAR 01) to use appropriate stratification (based on soil type, management variation etc.), and bin the baseline SOC accumulation rates accordingly. Since these are ex ante estimations, these are acceptable; the verification reports should present the baseline data and stratification for any instance(s) that would be verified.

Pre-project land use scenario is degraded grassland ecosystem which is the common situation in the project area. None of the laws and regulations mandate the restoration of degraded grassland the same as the project activities in Mexico. Therefore, the degradation of the grassland of the project area would continue in the absence of the project, the restoration measures implemented by the project activities such as rest grazing /rotational grazing is not mandated by any law, statute or other regulatory framework. Thus, the above claim by PP remains possible baseline scenario.

PP has documented the livestock stocking rates by the ranchers in the region over a seven year period, from 2015 to 2021. This information is included in Appendix 4 of the PD, demonstrating that there were no significant changes in the stocking rates between the baseline scenario (2015 to 2017) and project scenario (2018 to 2021). During site visit audits, ranchers have also been enquired about the practices followed by them in the absence of grazing plans in the baseline scenario. ranchers responded that the livestock grazed all over the year i.e., 365 days following unsustainable continuous grazing practice. During the on-site visit, it was confirmed that ranchers who are part of the project practiced unplanned grazing and none of them were practicing improved grazing before the project start date.

PP has used option 3 from Box 1 of the methodology, to collect qualitative and quantitative baseline information.. Due to the unavailability of the required qualitative and quantitative data for Options 1 and 2 of Box 1 in the applied methodology (as explained in footnote 72 in the PD by the PP), the PP has justified selecting Option 3. This option includes a signed attestation from the farmer or landowner of the sample field during the baseline period. The VVB has reviewed the surveyed and attested values collected and found no significant deviation from other evidence-supported values for similar fields. The justification provided by PP has been thoroughly cross-checked by the audit team and found that selection of option 3 is reasonable for this kind of project because there is no cropping practices involved in this project. Many of the sub-options suggested in Box 1 of the methodology are not applicable, for example, receipts or invoices, farm equipment specifications, logs or files containing machine and/or sensor data, etc. is not applicable since there are no activities in the baseline scenario which are associated with the given options. Only the stocking rates and type of animals need to be reported for the parameter P_{bsl} and $Days_{bsl}$ which have been collected after checking rancher cattle logbooks maintained at the ranch level. Hence the selection of option 3 is found acceptable. The data gathering was done via consultation & discussions with ranchers, verified and attested by the landowner of the ranches. Audit team checked the attested baseline survey forms and found to be in line with the requirements of the methodology. Furthermore, PP has taken expert opinion, who holds a PhD from the University of Montreal and a professor at the College of Postgraduates, one of the top research universities in Mexico, to analyze the status of all chosen project activities in the region during the project's commencement. Expert credentials /33/ has been checked and found that the expert has enough experience in this area with respect to grassland management.

As per the table 4 of the methodology, since this project is a grassland project, the data for minimum relevant parameters “Animal Type” and “Animal Stocking Rate” has been collected to report the baseline scenario in the project. Along with this PP has also collected additional information on grazing and management scenarios, water management conditions, grass species present in the region, pest and disease occurrence and others. The specifications related to crop planting and harvesting, nitrogen

fertilizer application, tillage and/or residue management are not applicable as no crop production, compost and synthetic N fertilizers are included in the baseline scenario. Any areas defined as cropland are considered non-eligible area and excluded from the eligible project areas. Tillage and crop residue removal are also not included as a management activity in the baseline scenario. This was analyzed the Baseline Survey conducted. PP analyzed baseline data, and the study shows that there is no use of any synthetic fertilizers, pesticides, herbicides, fungicides, or other agrochemicals on the lands at present. The study shows that there are not water management practices like gabions, keylines, etc being done in the project area. The ranches are not using any of these in the project scenario as no component of the project activity requires them. The survey also demonstrates the continuous grazing practice was followed by the ranchers participating in the project before the start of the project.

Baseline Grazing Scenario in elevation and terrain areas of the project

The VVB has taken several steps to ensure a reasonable level of assurance that unsustainable grazing practices are indeed the baseline scenario throughout the project area, even in areas that are inaccessible due to elevation and terrain challenges. A detailed site visit assessment was conducted, providing firsthand insights into the prevailing conditions. By physically exploring the project area, the VVB observed grazing practices, evaluated land conditions, and collected pertinent information.





Figure 6: Grazing at Elevation and Terrain areas of the project

Notably, despite the hilly and rocky terrain observed, grazing practices remain feasible. Insights gathered during site visits and assessments underscored the historical utilization of the area for grazing purposes, indicating a longstanding tradition of grazing in such environments. This determination is supported by key observations made during site visits and assessments:

1. **Stakeholder and Rancher Interviews:** Engaging with stakeholders and ranchers who have direct experience with the land and grazing practices provides valuable insights. These interviews revealed historical practices, current trends, and potential challenges associated with grazing in inaccessible terrain. Notably, ranchers emphasized that animals possess a level of intelligence often underestimated by humans. They described how livestock play a pivotal role in navigating challenging terrain, in fact assisting ranchers in finding pathways through high elevations. Additionally, ranchers highlighted the utilization of trails established by wild animals, which cattle leverage to access otherwise inaccessible areas. Furthermore, it was emphasized that many of these high, inaccessible terrains are characterized by bushy vegetation, rich in protein, making them highly desirable grazing grounds for cattle. Hence, despite challenging terrain, grazing activities were found to be adaptable, suggesting that livestock can navigate and utilize the landscape effectively.



Figure 4: Discussion with Partners & Ranchers

2. **Ranchers Experience and Expertise:** The ranchers' deep knowledge of local topography, weather patterns, and vegetation cycles, coupled with their well-designed management plans, enables them to make informed decisions about when and where to graze their animals. They recognize the importance of balancing livestock needs with the long-term health of the ecosystem, especially in fragile mountain environments where vegetation recovery is slow. This expertise ensures sustainable grazing practices that support both livestock productivity and ecosystem resilience.
3. **Observation of Animal behavior and suitable livestock varieties:** The VVB's acknowledgment that animals can traverse high terrain is also by observing animal behavior and movement patterns, the VVB can gain insights into how grazing activities occur in inaccessible areas. Utilizing trails made by wild animals for grazing cattle is a clever strategy that underscores the adaptability of livestock in rugged terrain. The ranchers also have hybrid varieties that are better adapted to challenging terrain further strengthens the assessment. Identifying breeds or varieties of livestock that can navigate steep terrain more easily ensures that grazing practices can persist even in inaccessible areas.



Figure 5: Animal Behaviour and Livestock Varieties

4. **Availability of water and forage:** Ranchers reported the presence of both man-made concrete dams, as well as natural springs and seasonal ponds within the area. These water sources play a critical role in ensuring access to water for cattle, even as they traverse higher terrain. Despite the complexities of elevation and terrain, necessary resources for grazing, including forage and water, were found to be accessible within the area. However, it's important to note that in the baseline situation, water availability poses a challenge. To address this issue, ranchers have begun building water storage structures, using solar energy to pump water from lowlands.



Figure 6: Water Conservation and Storage Structures

The ranchers highlighted following key challenges associated with grazing in high terrain:

1. **Wildlife Presence:** The presence of wildlife in the area poses a challenge, particularly during seasons when cattle are taken for grazing. However, this challenge is mitigated to some extent during winters when many wild animals go into hibernation.
2. **Water Shortage:** Availability of water can be limited to high terrain, posing a challenge for grazing activities.
3. **Overgrazing**
4. **Climate Change Impacts:** Changing climate patterns, including prolonged droughts and extreme weather events, further compound the challenges of grazing in high terrain by reducing available forage and water resources.

Despite these challenges, when asked about the necessity of excluding these areas from grazing, the ranchers expressed a clear stance against it. They emphasized that these areas have been accessible and utilized by cattle since ancient times. Instead, they advocate for implementing rest periods for these paddocks, similar to those implemented in flatter regions.

As it is evident through the above explanation that grazing is feasible at elevation and terrain, through our further discussion with the ranchers and partners, they emphasized in regions with varied elevation, continuous grazing particularly affects sloped areas where soil erosion is more severe. The removal of vegetation exposes the soil to wind and water erosion, which can lead to the formation of gullies and loss of fertile topsoil. Over time, the continuous grazing pressure leads to a shift in plant communities. Palatable species are often grazed out, allowing less desirable, more resilient species to dominate. This change in vegetation cover reduces the land's ability to support livestock and other wildlife, further degrading the ecosystem. By considering these factors, the VVB has established a reasonable level of assurance that unsustainable grazing practices persist as the baseline scenario throughout the project area, even in regions characterized by elevation and terrain challenges.

PP has updated the information on the length of the period used to develop the schedule of activities in the PD along with minimum specifications on grazing management practices as per the methodology.

The evidence used to establish the minimum specifications is also mentioned in the PD. A separate Appendix 4 has been added to the PD with the information on the type of each farm Animals in the Baseline Scenario along with Animal Stocking rates. PP also confirmed that ranchers that conducted improved grazing practices in Baseline Scenario were not considered to be part of this project. The same has been cross-checked and found satisfactory. However, the following CLs and CARs are raised during audit.

To VCS PRR findings round 1, PP has provided draft model validation report where audit team has reviewed that SOC stock at time $t=0$ is produced using the methods in the ATBD, and then inputted to an initialized RothC model, followed by generating yearly RothC outputs that are used correctly for the baseline emissions calculation, for each ranch in the instance 1. Since the model validation report is not final, FAR 01 is still valid.

CL 08, 09, 10, 12, 14, 15, and CAR 08, 09, 10, 11, 26, 28, 29 (also see CARs raised on Carbon_Focus_ATBD document) as raised and resolved successfully. Refer Appendix 2 for the same. However, FAR 01 is raised.

3.3.5 Additionality

PP has used the following method as per VCS methodology requirements V4.3, section 3.5.3 and methodology (VM0042) requirements to assess the additionality of the project.

Regulatory Surplus

The proposed project is not mandated by any law, statute or other regulatory framework, or for UNFCCC non-Annex I countries, any systematically enforced law, statute or other regulatory framework. This project is a voluntary activity undertaken by Boomitra.

In addition to the demonstration of regulatory surplus, as per the VM0042 methodology, additionality is determined by a project method where PP has used 2-step process outlined in the methodology:

Step 1: PP has demonstrated that project has several barriers to implement the project. PP has used several published literature that The proposed project activity faces a number of investments, technological, infrastructural, institutional and social barriers to its implementation described as below:

1. As per FAO study¹⁶, there are several barriers to adopt sustainable management practices in grasslands. They are financial capital barriers: activities require high initial investment which defies the prevailing view of tropical cattle ranching as a low-investment activity, ii) knowledge barriers: the technical complexity of some demands a specialized knowledge that is not available

¹⁶ Food and Agriculture Organization of the United Nations. Silvopastoral grazing in Colombia, Mexico and Brazil. Sustainability Pathways: Projects detail. <https://www.fao.org/nr/sustainability/sustainability-and-livestock/database/projects-detail/en/c/239470/>

among farmers, professionals, conventional academia, or commercial rural extension companies in the field (Calle, 2008),

2. Ranchers in these regions have not implemented significant changes to their practices in the past several decades and uptake rates for any changes are exceedingly slow, especially in communal lands¹⁷. This is a combination of socioeconomic barriers and general resistance to change in the absence of incentives. As observed over a period of more than 10 years using satellite data, the lands have largely remained as grasslands, but the vegetative cover is either low or has been decreasing (See LULC¹⁸ Excel file and folder).
3. A large number of the ranchers in the region have poor literacy^{19,20}. Literacy levels are low in many targeted ranch communities (particularly Ejidos) and their dependence on government financial support is high with very low access to social networks connecting them with higher levels of governance and decision-making. Their socioeconomic structure is very fragile and vulnerable. The ranches cannot independently adopt sustainable practices due to a lack of knowledge of techniques and their impacts on their grazing practices as well as their livelihoods. Many ranchers have been using the same practices their ancestors have been using for the past century.
4. For the Ejidos specifically, any change in practice occurring on communal land requires the consent of all the members, or at least the Ejido Council, to work²¹, and achieving such a universal consent to create change is a difficult and unlikely task, presenting a strong adoption barrier. In addition, many Ejidos have weak internal cooperation due to social networks primarily being organized around nuclear families. Due to severe poverty, families are primarily incentivized today to focus only on their own conditions and are not incentivized towards co-operation.

17 GRÜNWALDT, J., CASTELLARO, G., FLORES, E., MORALES-NIETO, C., VALDEZ-CEPEDA, R., GUEVARA, J. and GRÜNWALDT, E., 2016. Pastoralismo en zonas áridas de Latinoamérica: Argentina, Chile, México y Perú. *Revue Scientifique et Technique de l'OIE*, 35(2), pp.543-560.

¹⁸ Two sets of analysis has been done to check LULC variations among the participation ranchers. One set of analysis is done using MODIS/Terra Land Cover Types (500 m resolution) data. Because of its coarse spatial resolution and lack of data for particular region for particular time point, we found some issues with classifying the ranchers. Hence we used GLAD Global Land Cover and Land Use Change dataset which has 30-m spatial resolution we could find that all the project participant ranches remained grasslands.

¹⁹ OECD. 2022. *Mexico Country Note*. [online] Available at: <https://www.oecd.org/skills/piaac/publications/countryspecificmaterial/PIAAC_Country_Note_Mexico.pdf> [Accessed 19 January 2022].

²⁰ Padilla Rodriguez, B., Armellini, A. and Traxler, J., 2021. The Forgotten Ones: How Rural Teachers in Mexico are Facing the COVID19 Pandemic. *Online Learning*, 25(1).

²¹ Creekmore, M., 2000. EJIDO LAND VS. PRIVATE PROPERTY – WHAT'S THE DIFFERENCE?. *Arizona Journal of Real Estate & Business*, [online] Available at: <<https://www.stewart.com/content/dam/stewart/Microsites/mexico/pdfs/ejidoarticle.pdf>> [Accessed 19 January 2022].

5. There are a few laws that restrict ranchers from easily converting their grasslands to croplands or to sell^{22,23} but there are no rules or laws in place that prevent them from adopting new sustainable grazing practices. Apart from getting community consent to adopt any changes in practices, there are no adoption barriers in the region. Conversely, there are also no rules or laws that prevent overgrazing in Mexico. Unlike countries like the USA, there are also no federal incentives for the adoption of sustainable practices.
6. Our ground partners conduct awareness creation and capacity building work for the ranches. Due to financial constraints and other resource constraints, our ground partners are unable to expand the area of work and expedite the adoption of sustainable grassland management at scale. Hence, the activities have previously been confined to a small area. Carbon finance is the only mechanism that exists to promote these activities today, with the help of carbon credit payments going to local partners to fund their capacity building efforts. This funding stream is by far the largest funding source for the ground partners, often by an order of magnitude. Without these funds, these organizations could not do work at the level required to execute this project at its intended scale.
7. Although there are various national developmental banks operating in the region, access to rural finance is relatively low and government data also indicates that fewer than 3 of every 10,000 rural poor households have credit access. Additionally, 60% of the rural population live under the poverty line and 21.5% live under extreme poverty as per the latest government indicators²⁴. Project activities and typical ranch management do not involve cropping, and as a result, no farming-related loans are available to the ranchers at this point of time.

The above barriers would prevent the scenario of the project activity occurring without being registered as an AFOLU project, however they do not affect or prevent the implementation of the Scenario 1: Continuation of pre-project land use (continuous livestock grazing) which does not require any investment and is the most common land use in the project area.

Then proceed to Next Step (Common practice analysis) based on expert opinion in the region.

STEP 2: Common Practice Analysis

The primary project activity is rotational grazing, and this activity is relatively unknown in this region. No recent quantitative statewide or nationwide surveys exist, but an expert has given his opinion (attested with date) on the adoption rates of the project activities. Details of the expert opinion /38/ are provided separately for the VVB. As per his opinion, only 5% of ranches have adopted rotational grazing in the region. This practice has been primarily adopted on private lands with intensively managed and irrigated

²² Lexology. 2022. *In brief: agricultural land acquisition and use in Mexico*. [online] Available at: <<https://www.lexology.com/library/detail.aspx?g=568f5146-0f50-4ec5-b516-3ce5787d4732>> [Accessed 19 January 2022].

²³ Key, N., Munoz-Pina, C., de Janvry, A. and Sadoulet, E., 1998. *Social and Environmental Consequences of the Mexican Reforms: Common Pool Resources in the Ejido Sector*. [online] University of California, Berkeley. Available at: <<https://are.berkeley.edu/~esadoulet/papers/ejido.pdf>> [Accessed 19 January 2022].

²⁴ Torres Munguía JA, Martínez-Zarzoso I (2021) Examining gender inequalities in factors associated with income poverty in Mexican rural households. PLoS ONE 16(11): e0259187. <https://doi.org/10.1371/journal.pone.0259187>

forages production areas. Gabions and other ponds and microbasins areas have adoption rates of 5%, whereas keylines have an adoption rate of 1%. Thus, the 20% adoption rate threshold is met and each project activities is individually not common practice.

From the above analysis it is concluded that the project is not viable in baseline scenario, and additional financial support is required to develop, implement and sustain the project. The overall analysis and secondary literature review confirms that the project is additional and not viable under baseline scenario. All the steps are explained in detail in section 3.5 of the validated PD and adhere to all the steps and requirements of VCS standard. PP has taken expert opinion, who holds a PhD from the University of Montreal, to analyze the status of all chosen project activities in the region during the project's commencement. Expert has provided his opinion for insights into project activities about the local laws, barriers, climate and many other aspects, particularly within the Northern Mexico region. The expert opinion provided hold good to group project boundaries that includes northern Mexico region and is applicable to all future instances as all the future instances will be within the northern Mexico region boundaries as confirmed by the PP and same has been cross checked by the audit team and found satisfactory. Expert credentials /33/ has been checked and found that the expert has enough experience in this area with respect to grassland management. Mexico has an autonomous public body which is responsible for regulating and coordinating the national system of statistical and geographical information. Regularly this public body, publishes information about territory resources, population, economy, and characteristics of the country. In 2007, this body has published one data set on grasslands and information on the current practices followed by the ranchers in Mexico. So this dataset was not updated after 2007²⁵. Audit team gone through the INEGI website²⁶, and found no latest data available on adoption rates. Hence, the audit team accepted the expert opinion for the common practice analysis.

From the above analysis it is concluded that the project is not viable in baseline scenario, and additional financial support is required to develop, implement, and sustain the project.

CAR 12, 13, 14, 29 (see Carbon_focus_ATBD document related CARS) was raised and resolved successfully. Refer Appendix 2 for the same.

3.3.6 Quantification of GHG Emission Reductions and Removals

Baseline emissions

The Projects baseline emissions and carbon stock assumptions were assessed based on an analysis of the likeliest baseline scenario. Accounted emissions resulted from continuous grazing in the baseline scenario. The only pool accounted in the baseline scenario is Soil organic Carbon (SOC).

In Section 4 of the PD, as per the methodology requirements, the PP has provided the ER calculation procedure used to estimate changes in SOC sequestration in the ranch. The PP uses a unique combination of remote sensing technology and the RothC model to estimate SOC in the soil. A separate

²⁵ SOURCE: INEGI. United States of Mexico. Agricultural Census 2007, VIII Agricultural, Livestock and Forestry Census. Aguascalientes, Ags. 2009.

²⁶ National Institute of Statistics and Geography (INEGI)

document with detailed procedures for estimating SOC using remote sensing has also been provided. As per the methodology, the PP has chosen Approach 1 to estimate SOC in both baseline and project scenarios. SOC for both scenarios is modeled for each sample unit (each ranch in this project) using RothC modeling procedures. Baseline and project emissions are estimated according to the guidance provided in Table 6 of the methodology. As discussed in Section 3.2 of the PD, the RothC model requires certain inputs, which must be collected from appropriate sources. Some of the key inputs include soil organic carbon stock and bulk density, both of which are determined via remote sensing. The PP has provided a detailed explanation of the calibration procedures, how the ER estimation procedure accounts for all noted sources of error in the project and baseline emissions, how these errors are propagated, and finally, how uncertainties are deducted from the final ER estimation.

PP has used Quantification approach 1 from the methodology where the baseline is modelled (RothC) for each sample unit. The model serves to project stock change/emissions resulting from the schedule of agricultural management activities taking place in the baseline scenario. Further guidance on biophysical model inputs is elaborated in the table 6 from Methodology.

Quantification Approach 1 as given in VM0042, Version 1. Soil Organic Carbon levels are estimated using RothC model as described in the section 3.2 of PD.

Soil organic Carbon (SOC) stocks are estimated under Quantification Approach 1, using Equation 2 below:

$$SOC_{bsl,i,t} = \phi SOC_{bsl,i,t}$$

Where

$SOC_{bsl,i,t}$	Carbon Stocks in the soil organic carbon pool in the baseline scenario for sample unit i at the end of period t ; tCO _{2e} /unit area
$\phi SOC_{bsl,i,t}$	Modeled soil organic carbon pool in the baseline scenario for sample unit i at the end of period t ; tCO _{2e} /unit area
i	Sample unit

As per methodology, baseline is modelled for each sample unit (each ranch in this project). As per the guidance provided in the table 6 of the methodology, baseline emissions are estimated. As discussed in section 3.2 of PDD, RothC model needs certain inputs which needs to be collected from many valid sources. One of the key input is Soil Organic Stock and bulk density. This input is measure is using remote sensing technology with known uncertainty. These parameters are determined for t=0 via remote sensing²⁷.

²⁷ The specific measurement approach is available in depth in the accompanying CarbonFocus Algorithm Theoretical Basis Document available at validation to the VVB. There are no project emissions from any of the project activities of the project .

The Soil Organic Carbon and Bulk Density remote sensing technology is calibrated using a ground-truth primary dataset, sourced from a government source, Mexico's National Institute of Statistics and Geography (INEGI). INEGI's soil data is representative of the entire country and is thus found to be a representative and reliable source of data for the Northern Mexico region where this project is specifically located. PP has also presented 3 data harmonization checks/steps, consisting of (1) checking the comparability of the lab technique, (2) consistency of the sampling procedure, and (3) terminology and units of the data. These harmonization steps were deemed to have been carried out properly for the primary dataset, with all testing being dry combustion, samples for 30cm depth, and the storage of all data in a consistent set of units. The documentation presented by the PP in the PD Section 4.1 and the ATBD Section 5 with respect to this dataset have been reviewed and found to be appropriate. PP has shown the dataset covers wide portions of the Northern Mexico region. The dataset does have some spatial gaps in the broader region, and only 51 of the soil samples in the calibration dataset are physically located within the first instance ranches of the project, but the PP has shown that all the climate zones and soil texture types found within the initial sample units of the project are represented in the dataset. Based on the theoretical basis of the remote sensing technology used, it is believed that the climate zone and soil texture type will have the largest effect on potential results, so it is deemed to be important for the calibration dataset to be representative of the initial sample units in this regard. Furthermore, it was verified from the dataset's metadata that all samples used were collected from grassland areas, and any outliers in terms of inappropriately high soil organic carbon levels and bulk density levels for a temperate grassland ecosystem were appropriately removed. Additionally, PP has appropriately introduced eligibility criteria for the project concerning the applicability of the calibration dataset – only new sample units whose soil texture types and climate zones are represented in the dataset can be added in a new instance of the project. Thus, the same calibration dataset will be appropriate for future instances of the project as well. The project does not intend to have any further calibration data for future instances or future applications of the remote sensed soil carbon stock calculation in the project.

The main errors in the soil carbon levels in the calibration dataset are identified to be the uncertainties of the analytical measurement technique used (eg. dry combustion), and the error associated with matching point-level soil carbon measured values to satellite pixels that are much larger than a point. These errors are appropriately discussed by the PP and identified to be covered by the remote sensing result comparison to validation soil samples on an ongoing basis, which is part of the monitoring plan.

The calibration dataset is observed to be collected from 2005 to 2012, which predates the project. The ATBD document and Section 4.4.1 of the PD provide an explanation for why this dataset may be used to build a model that is representative of conditions in both the baseline and project scenarios of the project. The explanation relates to the physical framework of the PP's measurement technology (assessed further in the subsequent part of this section), and also identifies different potential sources of calibration drift over time and how they are minimized and mitigated in the project so the remote sensing system could be used repeatably. The audit team found the explanation to be reasonable, and thus a time correction factor is not relevant for the calibration dataset to be used for the project. Furthermore, the audit team found the ongoing validation sampling procedure in the monitoring plan to be appropriate for checking

that the physical framework of the PP's technology continues to work, the calibrations are appropriate, and assuring that there is no model drift.

The input data for the remote sensing technology for the calculation of initial soil carbon and bulk density values includes ESA and NASA satellite data from programs that have had long lifetimes and are projected to continue operations well into the future. The spatial coverage of the satellites have also been reviewed to confirm that the full grouped project boundaries are covered with regular imaging from the satellites. The data sources provide adequate spatial and temporal coverage to ensure that not only all the existing sample units of the project are covered, but any future sample units would also be appropriately covered.

Other soil parameters are determined from published soil maps, with known uncertainty. Climate variables parameters are sourced from a synthetic weather station. The following table outlines the model input parameters and their sourcing method.

At the time of validation, PP has provided a draft model validation report and the associated literature data used to calibrate and validate the RothC model. The ranches were analyzed to ensure that all PC/CFG combinations were covered, and that the IPCC climate zones, and soil types in the project were represented in the RothC validation literature. Furthermore, the model uncertainty bounds were found to be appropriately set with all validation data covered by the prediction intervals. The report and literature were found to be adequate, and the calculation of model prediction error in the baseline scenario with the literature data, of 3.587 tonCO₂e/ ha was found to be conservatively correct and reproducible through the provided spreadsheets. However FAR 01 is still valid since complete and final validation report is not available at the time of validation.

Input Data	VVB assessment and Source Used	Timing
Soil organic carbon stock at t=0 (tons C/ha)	The remote sensing technology for SOC stock and bulk density is found to meet the methodology requirement for: "Directly measured at t=0 or (back-) modeled to t=0 from measurements collected within +/-5 years of t =0, or determined for t=0 via emerging technologies (e.g., remote sensing) with known uncertainty." Further analysis on the evaluation of the remote sensing is provided below this table	Ex-ante
Monthly rainfall (mm)	ERA5 data is found to meet the requirements of using a synthetic weather station as per methodology ²⁸ . ERA5 is a state-of-the-art source for this information and is hence judged to be reliable.	Continuously Monitored Ex-ante

²⁸ Copernicus Climate Data Store. Copernicus Climate Data Store.
<https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land-monthly-means?tab=overview>

Input Data	VVB assessment and Source Used	Timing
Monthly open pan evaporation (mm)	ERA5 data is found to meet the requirements of using a synthetic weather station as per methodology ²⁹ . ERA5 is a state-of-the-art source for this information and is hence judged to be reliable.	Continuously Monitored Ex-ante
Average monthly mean air temperature (o C)	ERA5 data is found to meet the requirements of using a synthetic weather station as per methodology ³⁰ . ERA5 is a state-of-the-art source for this information and is hence judged to be reliable.	Continuously Monitored Ex-ante
Clay content of the soil	The ISRIC data source used meets the methodology requirement of using a published map with known uncertainty ³¹ .	Ex-ante
An estimate of the decomposability of the incoming plant material - the DPM/RPM ratio	The value used is directly from the RothC documentation and is thus judged to be reliable.	Ex-ante
Soil cover (Bare/Vegetated)	Given that the project takes place in a continuous native grassland and the baseline survey data reviewed shows no cropping/bare soil cycles, it is reasonable to substantiate a continuous cover.	Ex-ante
Monthly input of plant residues	The draft Model Validation Report provides details of this parameter, but since it is not finalized, this parameter's reliability must be re-evaluated as part of FAR 1 at verification.	Continuously Monitored Ex-ante
Monthly input of farmyard manure (FYM)	This source for this parameter is tied to the baseline survey data collected by the project, whose evaluation is mentioned earlier in this report.	Ex-ante
Depth of soil layer sampled	30cm is found to be appropriate, meeting methodology requirements for soil depth. In addition, to ensure that the remote sensing soil carbon measurement systems are able	Ex-ante

²⁹ Copernicus Climate Data Store. Copernicus Climate Data Store.

<https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land-monthly-means?tab=overview>

³⁰ Copernicus Climate Data Store. Copernicus Climate Data Store.

<https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land-monthly-means?tab=overview>

³¹ ISRIC World Soil Information. Soilgrids - global gridded soil information. www.isric.org.

<https://www.isric.org/explore/soilgrids>

Input Data	VVB assessment and Source Used	Timing
	to properly account for depth, the calibration data for the remote sensing system is controlled for compaction, by removing extremely high bulk density values. This is found to be an appropriate action to ensure QA/QC of the data set to allow for proper and consistent accounting of the depth implicitly in the remote sensing soil carbon input. Furthermore, the project only uses data from 0-30cm depth for its calibration and validation of the remote sensed soil carbon stock, and in all subsequent RothC calculations, in a proper manner.	

Table 2: Inputs to the models and their sources

As discussed above PP has used remote sensing to estimate the two key inputs i.e., Soil Organic Stock and bulk density. PP has submitted a separate document “*CarbonFocus_ATBD_Mexico.docx*”/29/ (confidential) where PP has explained the procedure to estimate Soil Organic Carbon Stock and bulk density.

The ATBD document outlines the procedure to a great amount of detail, demonstrating that the technology can be applied to measure SOC increments. Firstly, the audit team has reanalysed and reproduced some of the key results stated in the document, using raw data supplied by PP, and are convinced on the statistical ability of the technology to measure soil carbon increments at the depths (when applied over time) required by the methodology (VM0042 v1.0).

Secondly, the technology description (including general documentation and the principles and analyses used in the technology) provides reasonable basis to comprehend the science behind the technology and its capability to measure SOC. PP’s technology builds a model between soil carbon, and a soil physical property that is directly measured by satellite data. PP has cited available literature (refer ATBD document for more details) showing that a relationship between soil carbon and the soil physical property is known to exist. The technology thus builds a machine learning algorithm to develop an empirical understanding of this relationship calibrated to within the project location. The implications of such an approach are that as long as the calibration dataset is sufficiently representative of the project location and fully covers the domain of the soil physical property and the soil carbon, it should be able to build a system that measures soil carbon from the soil physical property. Likewise, PP has a system for bulk density that leverages satellite generated inputs and soil texture information that drive the physical relationships leading to bulk densities. This bulk density component is also developed in a data-driven way and relies on the same calibration dataset.

The remote sensing technology based estimation approach used in this project has specific set of applicability criteria to a given project, in particular: a) generalizability of the calibration/validation ground

truth soil samples to the project location, and conditions found within the specific project areas within the project boundaries, in accordance to VCS Standard and methodology requirements; b) a level of uncertainty to which the remote sensing estimates are made, for the purposes of overall uncertainty propagation, as mentioned in the methodology c) No impact to emission removal estimation conservativeness.

For the first criterion, it was found that the ground truth soil samples were drawn throughout the grouped project spatial boundaries, with a variation in soil carbon levels spanning the entire expected range in grasslands. The majority of data was also sourced from National or Governmental sources and are acceptable as best as they can get. Furthermore, as per methodology requirements, there are samples present to 30cm depth or more. Thus, the remote sensing system calibrated and validated using this data is expected to be generalizable and applicable to the region.

For the second criterion, on the uncertainty estimation, the specific remote sensing system used is not yet peer-reviewed, but PP has presented literature references (albeit sparing and is beyond the scope of PP) to similar approaches in the field, and PP has also presented an analysis involving both frequentist and Bayesian methods to substantiate the technology's uncertainty, which were found to be reasonable. Uncertainty has also been propagated for an example sample unit (ranch) for a demonstration of the approach, with a similar full analysis for each sample unit expected in the Monitoring Report. PP has also listed several different sources of potential uncertainty in the remote sensing results, dealing with: imperfect models, incomplete domain coverage, and input errors, and shown how proper QA/QC ensures that certain errors, such as domain coverage, are avoided, and how the frequentist and Bayesian approaches can fully account for the rest. Imperfect models may arise from errors in the calibration dataset, associated with the SOC values themselves (eg. from the analytical technique used), and how the SOC values are linked to pixels – pixels cover an area whereas the SOC values correspond to point sampling measurements. Thus, during the spatialization of the point sample to a pixel area, an error is introduced. PP has satisfactorily described these sources and shown they are covered by the calculation framework in the project. PP discusses incomplete domain coverage separately in the discussion on the calibration dataset and how it appropriately represents the project activity instances and thus incomplete domain coverage errors are minimized.

PP has also given descriptions of potential sources of model drift, which is a source of uncertainty that can develop over time, and provided QA/QC and data processing steps to ensure minimization of model drift and to ensure the remote sensing system is applicable for the project throughout the project longevity. Given that the validation sampling is done in every monitoring period to check these assumptions and ensure that different source of uncertainty are regularly accounted for with updated estimates, the audit team found the arguments to be reasonable and the procedures sufficiently conservative to ensure proper uncertainty accounting.

To fulfill the third criterion, PP has provided comparisons of the remote sensing technology's uncertainty to the expected uncertainty in conventional soil sampling project designs. Conventional soil sampling has both soil testing measurement/protocol errors and sampling design errors entering into uncertainty calculations. On the other hand, in the specific case of PP's technology, sampling design errors are

reasonable due to capturing data from every pixel (10m x 10m) within a sample unit, but pixel-specific measurement errors are higher than in lab soil testing. Given this tradeoff, PP has presented results that show comparisons of the two approaches, which show that for conventional sampling designs, as land area increases, the remote sensing approach quickly starts to gain higher accuracy in soil carbon stock quantification due to its lower sampling error. In addition, PP has provided reasonable justification that the resultant emission removal estimations are conservative, as high soil carbon levels tend to be slightly underestimated relative to ground truth soil samples and lower soil carbon levels slightly overestimated, resulting in a net underestimation of any increments; the approach is reasonable. Furthermore, It is advisable to consider the confidence interval of the entire range of SOC levels for their varied CI in calculating actual emission removals (As raised in FAR 02). Thus, the audit team found that with the available data and the bounds of practical possibilities, it is reasonable to arrive that all three of these applicability criteria were met for the technology used in this project.

Concerning the remote sensing soil organic carbon stock and bulk density, CAR 28 to 68 was raised and resolved reasonably. Refer to Appendix 2 for the same; however, FAR 2 is raised.

However, during PRR process, VCS has raised a finding (#11) where it has asked VVB must ensure that the project has addressed all matters pertaining to FAR 02 and CAR 32 in the current validation itself. Hence PP has produced the comparison between remote sensing SOC values and direct field and lab measurements and clear description of the approach taken for stratification in determining the SOC. Audit team checked the results provided by PP and assessment is given below.

To further evaluate the applicability and reliability of the remote sensing technology used, following Verra guidance, the criteria in Appendix 4 of VM0042 v2.0 (as mentioned PRR finding 11) is utilized to assess:

Criterion	Evaluation
At least 3 peer reviewed scientific articles	PP has presented more than 3 peer reviewed scientific articles that report remote sensing for SOC and BD, along with uncertainty estimations. Furthermore, PP has written a scientific journal manuscript on the specific approach used under this project that has been submitted for peer-review shortly.
SOP for sample processing and analysis adapted to the requirements of the remote sensing technique	PP has presented its SOP /12/ for soil sampling, which was found to be adequate.
Strategies to overcome potential measurement obstacles due to signal interference related to differences in soil moisture, soil aggregates, sunlight, shadow, coarse fragments	In the ATBD document, PP has presented strategies for taking into account the soil moisture and soil conditions, through the appropriate model covariates and localization of models. Furthermore, PP has provided a process to minimize interference from soil moisture, sunlight and

Criterion	Evaluation
	shadows by performing measurements at times of the year that are hot, dry and cloud-free.
Description of the technology and specific equipment and instrument to be applied, including spectral range covered by the instrument applied and the actual resolution of the measurements	PP has provided a full description of the technology in the ATBD, along with specific satellite instruments and their wavelengths, and resolutions, both temporal and spatial.
Description of pretreatment or preprocessing methods to analyze raw data	PP has detailed and justified appropriate preprocessing methods for both the calibration soil data and the satellite data in the ATBD. As part of the preprocessing, the soil data points are mapped to individual satellite data pixels through a process of spatialization that involves matching individual point values to the collocated pixel. Since the pixel contains more area than the specific data point, there are model imperfections introduced through this preprocessing method. PP has appropriately identified this source of error as a part of model errors in the ATBD Section 4.2.4 and the PD, and shown satisfactorily that it will be accounted for in the comparison to validation samples and the variance measured in the PPDs for uncertainty propagation.
Description of the modeling approach applied for estimating SOC content and BD, including model type (e.g., partial least squares regression) and model features/parameters	PP has detailed the modeling approach, model type and features in the ATBD, for both SOC and BD.
Description of randomized data-splitting for model calibration/training and validation/testing	PP has detailed the calibration, training, testing and ongoing validation approach in the ATBD, including the data-splitting used.
Demonstration that calibration and validation data are representative of the actual project area in terms of SOC content, clay type, clay content, Munsell soil color and application of organic amendments, where relevant. or field-moist measurements, extensive	PP has demonstrated the datasets are representative in terms of SOC range, soil types, geographic coverage of the project region, soil moisture range and other parameters in the ATBD and responses to findings.

Criterion	Evaluation
verification of predictive performance across a wide range of moisture contents is required.	
Goodness-of-fit metrics and descriptive statistics from the dataset, such as RMSE, R2, RPIQ, bias and Lin's CCC or other suitable parameters	PP has provided GOF metrics in the ATBD and in the PD Section 4.5.1. The RMSE metrics have been reproduced, for both the test datasets used during calibration and the ongoing validation soil sampling that PP undertakes to ensure the system works. PP presents an RMSE of 0.397wt% for SOC% and 0.142 ton/m3 for BD based on the validation soil sampling associated with the first monitoring period. PP has shown these metrics are calculated based on comparisons of satellite pixels to the validation sample points, and thus represent both the point uncertainty and the pixel uncertainty, which are the same. Furthermore, the errors are shown for both the SOC calculation and the Bulk Density calculation as required for both parameters, in the way that they are being calculated and used in the project emission and baseline emission calculations. Thus the audit team concludes that the approaches used for both SOC measurement and Bulk Density measurement appropriately quantify error and accuracy for both.
Description of the approach that will be used to generate posterior predictive distributions (PPDs) or intervals which will be used to propagate error from the model to calculations of the uncertainty deduction	PP has outlined the strategy for PPD generation in the ATBD and presented example data in the PD. The strategy for PPD generation was deemed to be appropriate. PP has showcased ranch-level data that presents a ranch-level error of total SOC stock (after taking into account both BD and SOC%) of 4.7 tons CO2e/acre, which will be used for further error propagation. Based on the results of soil carbon stock PPDs at the start and end of the monitoring period, PP has produced a soil carbon stock change PPD and determined a prediction interval for the stock change from it, of 6.01 tons CO2e/acre. This prediction interval is used for the minimum detection limit of the system, and the calculation procedure to determine it was found to be appropriate.

Criterion	Evaluation
Demonstration that samples must be chosen in an unbiased manner such that they are representative of the project conditions and sampling design	PP is undertaking 100% sampling of the project area with the remote sensing at a pixel level, with 30mx30m pixel size.
Subsetting of calibration datasets to improve accuracy	PP has subsetting the calibration data geographically to only the project region in order to improve accuracy and this was deemed to be appropriate.

The criteria in the above table have been demonstrated by PP for SOC percent & Bulk Density.

In addition to the above, the PP has demonstrated comparisons to conventional soil sampling strategies followed by gold standard dry combustion soil testing, and has satisfactorily shown comparable results to the conventional strategy.

Hence FAR 02 and CAR 32 has closed satisfactorily. PP is undertaking ongoing QA/QC (See Section 5.3.7 of PD) of the remote sensing calculations throughout the project. Before every time the remote sensing is used in this project, PP undertakes to 2 checks, in terms of calibration and validation. For calibration, PP proposes to check that all sample units in the project, both existing and any new added during a verification event, continue to be representative of the climate zone and soil texture types of the calibration dataset, which as mentioned earlier, are key criteria to ensure appropriateness of the remote sensing calibration. For validation, PP has introduced in the monitoring plan to take ongoing soil sampling with dry combustion soil testing to compare with the remote sensing results, for each soil texture type within the project, to ensure continued appropriateness of remote sensing to the project areas. The soil stratification and sampling plan for this validation dataset collection was found to be adequate and sufficiently controlling for different common sources of errors in soil sampling and testing (Eg. laboratory technique variability, sample collection protocol variability etc). These two checks (calibration check and validation check) are deemed to be the appropriate checks to ensure that the remote sensing algorithm continues to be valid for the project area.

PP has demonstrated the applicability of the RothC model for this project through literature references showing applicability and uncertainties in similar grassland conditions. The PP are required to present a full modelling plan as required under VMD0053 (v1.0) in the Model Validation report at the time of verification, that include sufficient consideration to the different baseline scenarios, project area stratification (Associated with FAR 01).

PP has provided a supplementary spreadsheet /45/outlining the full end-to-end calculation process for a ranch, starting from the satellite band data sourced, going through the remote sensed SOC determination and RothC runs, model prediction error calculations, SOC mean squared error against the validation sampling, 100 Bayesian Monte Carlo simulations for calculation of Predictive Posterior Distributions, and culminating in the final uncertainty calculation and emission removal estimation. The audit team has gone through the calculations, equations used, and input data sourced, and found the

results to be accurate and appropriate, meeting the requirements of the methodology, and fully following Quantification Approach 1.

Finally, albeit beyond the scope of the auditing process, the audit team would like to recommend the PP to publish the capabilities of the technology in peer reviewed journal articles. Such publications could benefit from comparing measurements of current SOC status using standard methods (manual sampling and dry combustion method of analysis) and the PP's technology across a spatial variation (over a large area of land) as a proxy to tell apart small changes in SOC.

During the VCS PRR review, VCS has identified the need for further evidence associated with the calculation of the uncertainty of SOC stocks determined by the remote sensing AI and biogeochemical models. There is a gap between how the uncertainty from extrapolating point to pixel is accounted for, and to address this, VCS has suggested adding a FAR 05 that needs to be presented by PP at the time of the first verification.

Carbon capture in soils are crucial to achieve global net zero targets and has huge potential. However, the current classical approach is cumbersome and expensive. Technology applications such as this project are thus relevant and crucial. In the absence of clear guidelines in the VM0042 methodology for remote sensing approach, we have assessed the project documents with utmost rigor and care. The PP is further advised to factor in reasonable developments in both science and methodology to be as conservative as realistically possible in their estimates.

3.3.7 Project emissions

As seen in Section 3.3, this project only includes Soil Organic Carbon stock change in the project boundary, which will be quantified with Quantification Approach 1 as given in VM0042. According to the methodology, Soil Organic Carbon stocks in the project scenario as described in section 4.1 where subscript *bsl* is substituted with *wp*. However, if any activity contributes or have emissions during project implementation and monitoring will be reported in the subsequent monitoring cycles. PP at the time of validation claims that there are no project emissions. However, PP has mentioned that monitoring will involve monitoring of activities, if any in the project scenario which contributes to project emissions.

As required under Quantification Approach 1, soil organic carbon in the project scenario must be measured and modeled. PP is using remote sensing for the initial measurement of soil organic carbon RothC to estimate soil carbon levels for each year of the project for each sample unit. The PP then uses the differences in soil carbon levels outputted by RothC to compute the project emissions. Furthermore, remote-sensed measurements of soil organic carbon are set to be repeated by PP every 5 years or more frequently, for each sample unit, as required by the methodology. These repeated measurements will be used in the appropriate monitoring periods to re-calibrate and true-up the RothC calculations for the project scenario. Hence, the design of the project emissions calculation is found to be compliant with the requirements of the methodology. Project emission data collected and calculated under this framework have been evaluated in the project's ER spreadsheet and found to be compliant with the design. Further details on the assessment of the RothC and remote sensing of soil carbon are provided in Section 3.3.6 above.

CAR 28 to 68 was raised and resolved reasonably. Refer to Appendix 2 for the same; however, FAR 2 is raised.

3.3.8 Leakage

There are no direct or indirect leakages expected from this project activity. The proposed activity is completely in-situ in nature, which does not contribute to indirect leakages or new emissions elsewhere. As clearly described in the project activity description section of the PD, the activity proposed is purely to bring behavioral change in the practices followed in the baseline. The project scenario does not involve any such activity that leads to new emissions elsewhere.

The methodology also assumes no leakage if certain conditions are met:

- 1) No new application of manure from outside the project area (i.e., manure applied in the project from outside of the project area, that was not previously applied in the historical baseline period), The project activity does not involve any such application of manure from outside the project area.
- 2) No productivity declines. As noted in Section 2.5, productivity declines are not expected to occur, according to the academic literature. Regardless, as required by the methodology, productivity will be measured every ten years and changes in productivity will be quantified as per Eq 30 or Eq 31 in the methodology.
- 3) No displacement of livestock outside of the project boundary. The entire legal area of every ranch participating in the project is included in the project. The ranchers do not graze their livestock in any area outside of their ranch. Furthermore, as noted in Section 2.5, livestock numbers are not expected to decline with the project activity, according to the academic literature. Regardless of the possibility of any such declines, this project also does not claim credit for reductions in N₂O or CH₄ emission from reductions in enteric emission due to reduced livestock numbers. Thus, this leakage accounting is not required either. During site visits it has been checked the purpose of the livestock rearing with ranchers. Ranchers rear cattle as a livelihood activity. They supply cow and calf to beef industry. PP also confirmed in the PD that project activities will increase forage availability, and livestock will thereby have good-quality grass to eat and hence displacement of livestock is not expected to happen.

CAR 28 to 68 was raised and resolved reasonably. Refer to Appendix 2 for the same; however, FAR 2 is raised.

3.3.9 Uncertainty calculation

As per section 8.6 of methodology, total uncertainty deductions are quantified using equation 46 as shown below.

$$UNC_t = MIN \left(100\%, MAX \left(0, \frac{T \sqrt{\sum_{\bullet} s_{\Delta \bullet, t}^2}}{\overline{\Delta CO2_t} + \overline{\Delta CH4_t} + \overline{\Delta N2O_t}} - 15\% \right) \right)$$

Where,

UNC_t	Uncertainty deduction in year t (expressed as the extent to which the half width of the 95% confidence interval, as a percentage of the mean, exceeds the threshold of 15%); unitless number between 0 and 1
$\sum_{\bullet}$	Sum over pools and gases CO ₂ _soil, CTREE, CSHRUB, 24 CH ₄ _SOC, CH ₄ _ent, CH ₄ _md, and N ₂ O_soil, where Quantification Approaches 1 or 2 were employed.
$s^2_{\Delta \bullet, t}$	Variance of the estimate of $\Delta \bullet t$. ($\Delta \bullet t$ = mean emission reductions from gas and pool $\bullet$ at time t) (see); (t CO _{2e} /unit area)
$\overline{\Delta CO2_t}$	Areal average carbon dioxide emission reductions in year t; t CO _{2e} /unit area
$\overline{\Delta CH4_t}$	Areal average methane emission reductions in year t; t CO _{2e} /unit area
$\overline{\Delta N2O_t}$	Areal average nitrous oxide emission reductions in year t; t CO _{2e} /unit area
T	Critical value of a student's t-distribution for significance level $\alpha = 0.05$ (i.e., a $1 - \alpha = 95\%$ confidence interval) and the degrees of freedom df appropriate for the design used (e.g., $df = n - 1$ for a simple random sample of n sample units)
15%	Threshold beyond which there is an uncertainty deduction
$\bullet$	Gas or Pool

The project uses Quantification Approach 1, under which the main sources of uncertainty identified by the project are model prediction error, and measurement errors in the SOC stock. Audit justifications for these two errors specifically are provided in Section 3.3.6. Beyond these, the standard error equations provided by the PP in Section 4.4 of the PD to compute the total uncertainty in each project and baseline condition, and the combined error, were found to be appropriate. In this project, the combined error involves propagating the error from the SOC measurement through the biogeochemical model, resulting in a final error that encompasses both that of the SOC measurement and that of the biogeochemical model, for both project and baseline scenarios, across all sample units.

The PP measures the baseline and project emissions from the RothC model output PP presents a detailed analysis and procedure in Section 4.4 of the PD around the running of MC simulations of the RothC SOC input error distribution from remote sensing, which is in accordance with the guidance in VM0042 v2.0 Section 8.6.1.2.2, and PP shows that The PP has appropriately presented in the monitoring

plan that this should be repeated as a part of the modeling plan in future verifications of the project. The PP then combines the two scenario-specific errors (project scenario and baseline scenario) together:

$$s_{\Delta,i,t}^2 = s_{\Delta,i,t,proj}^2 + s_{\Delta,i,t,bsl}^2 = s_{RS-proj-MC,i,t}^2 + s^2 \bullet_{proj} + s_{RS-bsl-MC,i,t}^2 + s^2 \bullet_{bsl}$$

This equation is also appropriate as it represents both the project and baseline errors together in an appropriate conservative manner.

The PP finally combines the error across all sample units, with an assumption of independence across the units that is appropriate since they are each independent ranches managed separately:

$$s_{\Delta,t}^2 = \frac{1}{n^2} \sum_i s_{\Delta,i,t}^2$$

Since there are no other GHG pools in the project other than soil organic carbon, the combined error above is directly used in the uncertainty deduction equation.

For the usage of the process-based model under Quantification Approach 1 and its associated model prediction uncertainties. Refer to Section 3.3.6 for audit justification.

The audit team looked into the PP's assumptions and note that they are supported by published peer reviewed scientific literature, government data as well as verifiable local scientific expertise. These were applied with reasonable conservativeness and assumptions.

The Project will undertake the following activities.

Planned rotational grazing.:

- Livestock operators will decrease the size of their pastures by using fencing (either fixed or moving) to divide up existing pastures.
- Animals will not graze the same location more than once within the grazing period in the year. Project participants increased herder to continually move the livestock to ensure equal grazing across all forage species. This step will be monitored by project implementer with the help of PP.
- Animals will be actively herded and moved to new forage.
- Animal herds will be moved across the landscape so as to avoid over-use of areas near settlements or water points.
- Resting serves the purpose of allowing grass seed reserves to recover. A seed rest is important especially where low forage production is expected.

- Resting especially over the wet season is important to allow germination and establishment of decrease species. Resting from October (the beginning of the wet season) until September (end of dry season) is recommended.

Water Management activities: Since this is an arid region, some ranchers are also encouraged to adopt various water conservation related measures that enhance biomass growth and thus increase soil carbon. As discussed in Section 1.1 and in section 1.13 of PD, ranchers in the project area are facing serious water availability issues due to less rainfall in the region. Project areas are located in arid regions of northern Mexico and have been experiencing severe water scarcity. The region is highly prone to flash floods – wherein a large amount of rainfall occurs in just a few hours and the water from the ensuing rainfall moves very fast across the land surface before reaching the endorheic seasonal lakes of the region. Very little water infiltration occurs in highly degraded lands with sparse vegetation, and thus most of the rainwater is lost and unavailable for regenerating the land. Water conservation practices are used to mitigate this loss and some examples of these interventions include Keylines, Gabions and Ponds.

The validation team reviewed the claims made by PP in the PD with appropriate information and evidence provided by PP and also with online platform and found they are accurate.

The total baseline, project and leakage emissions estimated during the project lifetime are mentioned in the table below:

Total baseline emissions tCO ₂ e	Total project emissions tCO ₂ e	Total leakage emissions tCO ₂ e	Buffer (11%) tCO ₂ e	Net Emission Removals (tCO ₂ e)
(3,783,988.28)	26,189,140.81	0	3,049,069	24,669,598

CAR 28 to 68 was raised and resolved reasonably. Refer to Appendix 2 for the same; however, FAR 2 is raised.

3.3.10 Net emission reductions and removals (NERs)

The NER is calculated as per the applied methodology. The audit team confirmed that NER have been estimated in accordance with steps and equations mentioned in the latest version of the applied methodology. The calculation was carefully analysed for accuracy according to the methodology.

The Risk Factor parameter of the Project was estimated through the document VCS AFOLU Non-Permanence Risk Tool, resulting in 11%.

VCUs - The estimated GHG credits eligible for issuance as VCUs has been calculated in line the latest version of the applied methodology. The project has used proper parameters and resulted in an accurate estimate of ex-ante total emissions reductions.

The excel sheet submitted by the PP was evaluated and found to be appropriate and in line with the applied methodology.

	Ex ante baseline anthropogenic GHG emission reductions tCO2e	Ex ante buffer credits tCO2e	Net Emission Removals (tCO2e)
Total	(3,783,988.28)	3,049,069	24,669,598
Annual Average	(189,199.41)	152453.45	1,233,480

Overall, the PP has followed the exact steps mentioned in the latest version of the applied methodology. The steps have been applied correctly to calculate baseline emissions, project emissions, leakage and net GHG emission reductions and removals for the baseline period. With 139 sample units in the first monitoring period, the final uncertainty deduction calculation has 138 degrees of freedom, and the project appropriately uses the 5% significance value of the t-distribution with 138 degrees of freedom, as required in the Eq 46 of the methodology. The quantification of related emissions is described in detail in the validated PD.

The audit team can confirm that the PD and the ER excel sheets contains a very high level of detail regarding the calculation of GHG emission reductions, such that the following are true:

- All relevant assumptions and data are listed in the project description, including their references and sources.
- All data and parameter values used in the project description are considered reasonable in the context of the project.
- All estimates of the baseline emissions can be replicated using the data and parameter values provided in the project description.

3.3.11 Methodology Deviations

There is no deviation from the methodology found in the PD.

3.3.12 Monitoring Plan

All parameters supplied in the monitoring plan were examined by the audit team in relation to the methodology's standards and requirements, and everything was deemed to be in order. It is fully described in VCS PD, where the proponent describes data and parameters at validation, data and

parameters monitored and the specific monitoring period. It is supported by three documents provided by the proponent: procedures for calculating carbon stocks and variations, the project management and monitoring staff (local communities) are responsible for the monitoring of project. The quality assurance and quality control (QA/QC) systems are already in place and was checked by the audit team. Section 5.3 of the PD details the monitoring duties and skills of each technical staff member. The monitoring strategy integrates the most recent scientific findings and new technology as they become available in order to maximize the effectiveness and efficiency of the monitoring practices. Section 5.3 of the validated PD, which is also consistent with the most recent version of the applicable methodology (VM0042/Version 1), includes information about the monitoring plan's specifics and the frequency of project activities.

Since measurements are done for each project participant rancher separately, which implies 100% sampling. Hence, there is no requirement for this project to adopt any sampling techniques for project areas.

Below is a list of the parameters that need to be watched, along with a description of the actions taken to confirm that the monitoring techniques were done correctly.

Data and parameters available at validation (section 5.1 of VCS PD).

Parameter	Unit	Description	Value		Source
AR	Percent	Weighted average adoption rate	Activity Name	% of adoption rate	An expert has provided his opinion with signed and dated attestation on the practices.
			Rotational grazing	5%	
			Keylines	1%	
			Gabions	5%	
			Ponds and Micro basin	5%	
VVB Assessment:					
PP has provided the expert opinion/33/ along with the qualification details of the expert to substantiate the average adoption rates of the proposed activities. The validation team confirmed that the value of the parameter is determined in line with applied methodology /20/.					
Area _{an}	Hectare	Area of proposed project-level	589,659.37		Management plans, Rancher records, project activity commitments

Parameter	Unit	Description	Value	Source
		adoption of each activity		
VVB Assessment: The area of each grazing ranch associated with the project has been calculated by PP. The ranch boundaries provided by the ranchers from the agreement along with management plans and were confirmed from the partner and were cross-checked with GIS data. The KML files /10/ were checked to confirm the data and was found accurate.				
EA_{an}	Percent	Adoption rate of the n largest most common proposed project activity in the region	5%	An expert has provided his opinion with signed and dated attestation on the practices.
VVB Assessment: PP has substantiated this parameter by providing the Expert Opinion/33/ along with the Qualification of the expert. From the attested Expert Opinion, the value has been cross-checked and found satisfactory. The validation team confirmed that the value of the parameter is determined in line with applied methodology /20/.				
A_0	Hectares	Project area	At the time of validation, ~589,659.37 hectare of land has been included (which is ~95% of the total land included in the 1 instance)	Measured in project area. (Using geospatial techniques, the cumulative area of the ranches under this project is calculated. Separate KML files are provided at validation for the VVB.)
VVB Assessment: The area of each grazing ranch associated with the project has been calculated by PP. The ranch boundaries provided by the ranchers from the agreement along with management plans and were confirmed from the partner and reviewed through the GIS data. The KML files /10/ were checked to confirm the data and was found accurate.				
$P_{bsl,i,t}$	Head	Population of grazing livestock in the baseline scenario of type I in sample unit i in year t	Varies from ranch to ranch.	Baseline spreadsheet of list of ranches for a list of values and analysis for Instance 01.
VVB Assessment: The values for this parameter was determined from the baseline survey conducted for the ranchers. The values which is considered appropriate as per the applied methodology /20/ and the values have been correctly applied in the ER calculation sheet /4/.				
$Days_{bsl,i,t}$	Days	Average grazing days per head in the baseline	365.25	Rancher field data.

Parameter	Unit	Description	Value	Source
		scenario inside sample unit i for each livestock type l in year t .		
VVB Assessment: The value applied for the parameter is 365.25 and the total number of days has been calculated from ranch field data. The values of this parameter is valid and adheres to the requirements of applied methodology VM0042 /20/.				
DPM/RPM	Fraction	An estimate of the decomposability of the incoming plant material	0.67	RothC model default value (https://www.rothamsted.ac.uk/sites/default/files/RothC_guide_WIN.pdf)
VVB Assessment: The values provided has been calculated and measured using VMD0053 Module /21/ for Model Calibration, Validation and uncertainty guidance for the methodology /20/. The values of this parameter is valid and adheres to the requirements of applied methodology VM0042 /20/.				
OD	CM	Depth of Soil layer sampled	30	Default as per methodological requirements.

Data and parameters monitored (section 5.2 of VCS PD)

Parameter	Unit	Description	Frequency and monitoring equipment	Source
AR	Percent	Weighted average adoption rate	Whenever new instances are added	As per methodological requirements. (Filed Monitoring data)
VVB Assessment: The frequency of monitoring of this parameter is whenever a new instance is added to the grouped project. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD /7/ and methodology /20/. The validation team confirmed that the value of the parameter to be determined is in line with applied methodology /20/. This has been verified by the validation team during the on-site visit, hence considered valid.				
$Area_{an}$	Unit area (hectares or acres)	Area of proposed project-level adoption of each activity	Whenever a new instance is added	As per methodological requirements. (Rancher records and project activity commitments)
VVB Assessment: The area of each grazing ranch is to be estimated prior to each verification. The frequency of the monitoring of the parameter is done whenever a new instance is added to the grouped project. The rancher records and project activity commitments will be used to determine the area of sample unit added. The validation team confirmed that the value of the parameter to be determined is in line with applied methodology/20/. This has been verified by the validation team during the on-site visit, hence considered valid.				

Parameter	Unit	Description	Frequency and monitoring equipment	Source
EA_{an}	Percent	Adoption rate of the n largest most common proposed project activity in the region	Whenever a new instance is added	As per methodological requirements Field data is collected
VVB Assessment: PP has substantiated this parameter by providing the Expert Opinion/33/ along with the Qualification of the expert. The frequency of the monitoring of this parameter is done whenever a new instance is added to the grouped project. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The validation team confirmed that the value of the parameter to be determined is in line with applied methodology /20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
A_i	Unit area	Area of sample unit i	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years.	Determined in project area as part of monitoring plan.
VVB Assessment: The area of each ranch is to be calculated using GIS tools. The frequency of the monitoring of this parameter is be conducted at least every five years, or prior to each verification event if less than five years.				
i	Dimensionless	Sample unit: defined area that is selected for measurement and monitoring, such as a field	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Determined in project area as part of monitoring plan. Delineation of the sample unit area may use a combination of GIS coverages, ground survey data, remote imagery (satellite or aerial photographs), or other appropriate data. Any imagery or GIS datasets used must be geo-registered referencing corner points, clear landmarks or other intersection points.
VVB Assessment: The value of the parameter is to be calculated using GIS tools. The frequency of the monitoring of this parameter is be conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The validation team confirmed that the value of the parameter to be				

Parameter	Unit	Description	Frequency and monitoring equipment	Source
determined is in line with applied methodology /20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
L	Dimensionless	Type of livestock	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Determined in sample unit <i>i</i>
VVB Assessment: The frequency of monitoring of this parameter must be conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The validation team confirmed that the value of the parameter to be determined to be in line with applied methodology /20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
•	Dimensionless	Gas or pool	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Determined in sample unit <i>i</i>
VVB Assessment: The frequency of the monitoring of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The validation team confirmed that the value of the parameter to be determined to be in line with applied methodology /20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
$fSOC_{bsl,i,t}$	t CO _{2e} /unit area	Modeled soil organic carbon stocks pool in the baseline scenario for sample unit <i>i</i> at time <i>t</i>	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Modeled in the project area (Remote sensing along with RothC model) using Calculation method noted in the CarbonFocus Algorithm Theoretical Basis Document
VVB Assessment: The value of the parameter is determined through Soil Organic Carbon Stocks pool. The frequency of monitoring of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
$SOC_{bsl,i,t}$	t CO _{2e} /unit area	Areal-average soil organic carbon stocks in the baseline scenario for sample unit <i>i</i> in year <i>t</i>	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Modeled in the project area (Remote sensing along with RothC model) using Calculation method noted in the CarbonFocus Algorithm Theoretical Basis Document

Parameter	Unit	Description	Frequency and monitoring equipment	Source
VVB Assessment: The value of the parameter is determined through areal-average SOC stocks in the baseline scenario. The frequency of monitoring of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
$SOC_{wp,i,t}$	t CO _{2e} /unit area	Areal-average soil organic carbon stocks in the project scenario for sample unit i in year t	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Modeled in the project area (Remote sensing along with RothC model) using Calculation method noted in the CarbonFocus Algorithm Theoretical Basis Document
VVB Assessment: The value of the parameter is determined through areal-average SOC stocks in the project scenario. The frequency of monitoring of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid. In accordance with the methodology's Quantification Approach 1, the value of this parameter comes from the output of the RothC model that is run for the project scenario, generating outputs on a yearly basis. The RothC model is also re-calibrated/true-upped with repeat measurements of the soil carbon levels with a frequency of 5 years or more frequency, as confirmed in the monitoring plan of the project.				
$\frac{\Delta \bullet, t}{\bullet t}$	t CO _{2e} /unit area	Average emission reductions from pool or source $\bullet$, or stock of pool $\bullet$, in year t	Calculations and recording must be conducted at least every five years, or prior to each verification event if less than five years	Calculated values in the project area
VVB Assessment: The value of the parameter will be calculated. The frequency of monitoring (calculating and recording) of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
$P_{wp,i,t}$	Head	Population of grazing livestock in the project scenario of type i in sample unit i in year t	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Project participant survey once every 2 years
VVB Assessment:				

Parameter	Unit	Description	Frequency and monitoring equipment	Source
The value of the parameter will be determined by direct consultation through survey once every 2 years. The frequency of monitoring (calculating and recording) of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
$Days_{wp,i,t}$	Days	Average grazing days per head in the project scenario inside sample unit i for each livestock type l in year t	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Project participant survey
VVB Assessment: The value of the parameter will be determined by direct consultation through survey once every 2 years. The frequency of monitoring (calculating and recording) of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
LE_t	tCO ₂ e	Leakage in year t ;	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	Project participant survey
VVB Assessment: The value of the parameter taken is 0 in line with the methodology section 8.4 /20/. The frequency of monitoring of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				
ΔP	Percent	Change in productivity	Every 10 years	Project participant survey
VVB Assessment: The frequency of the monitoring of data is every 10 years.				
$P_{wp,p}$	Productivity (e.g., kg) per hectare	Average productivity for product p during the project period	Each growing season	Project participant survey
VVB Assessment: The value of the parameter will be determined through direct measurement. The value of the parameter will be calculated at each growing season. Measuring and reporting frequency is in accordance with the monitoring plan, as documented in the PD/7/ and methodology/20/. The validation team confirmed that the value of the parameter to be determined is in line with the applied methodology /20/.				

Parameter	Unit	Description	Frequency and monitoring equipment	Source
p	Numbers	Livestock count	Recorded every month	Project Survey Rancher
VVB Assessment: The value of the parameter will be calculated at each growing season.				
<i>Buffer_t</i>	tCO _{2e}	Number of buffer credits to be contributed to the AFOLU pooled buffer account in year <i>t</i>	Monitoring must be conducted at least every five years, or prior to each verification event if less than five years	The number of buffer credits to be contributed to the AFOLU pooled buffer account must be determined by applying the latest version of the VCS AFOLU Non-Permanence Risk Tool
VVB Assessment: The value of the parameter will be calculated. The frequency of monitoring of this parameter is conducted at least every five years, or prior to each verification event if less than five years. Measuring and reporting frequency is in accordance with monitoring plan, as documented in the PD/7/ and methodology/20/. The QA/QC procedures were found to be in place. The validation team confirmed that the values of the parameter to be determined is in line with the applied methodology/20/. This has been verified by the validation team during the on- site visit, hence considered valid.				

The VVB has validated section 5.1 and 5.2 of the PD and found that the monitoring plan comprises all parameters required by the methodology, including those defined at validation and those that need to be observed and verified at the time of ex-post monitoring.

The project proponent along with implementation partners hired local communities (monitoring staff) for daily supervision and data management during the project implementation while office manager oversees the whole working group. Implementation partner will be responsible for carrying out the monitoring and PP is responsible for reporting and supporting validation and verification if the project.

The evaluation team has examined each parameter listed in the monitoring plan and contrasted it with the methodology's requirements. In that way, the PD contains all necessary parameters, with adequate descriptions as to source of data, measurements procedures, monitoring frequency, monitoring equipment and QA/QC procedures to be applied. The selected monitoring frequency of the parameters is consistent with the requirements of methodological requirements.

The conventional soil sampling plan for QA/QC of SOC measurements by the remote sensing model was found to be reasonable. The project stratifies by different soil types, which are the key consideration for showing the remote sensing model's accuracy and generalizability across the vast project region. Furthermore, the sampling SOP and lab testing requirements were found to be adequate and aligned with best practices.

FAR 01 and 02 was raised. Refer Appendix 2 for the same.

3.4 Non-Permanence Risk Analysis

The proponent used the "AFOLU Non-permanence risk tool v4.0" in line with VCS specifications to analyze the risk in terms of internal risk, external risk, natural risk, and risk mitigation strategies. The non-permanence risk report and the Excel risk tool are provided by the project proponent.

The VCS recommendations were used to calculate each risk category. Through document analysis, actual visits to the project area, and interviews, the material was verified and cross-checked. The evaluation's specifics are listed below.

Risk Rating	PP Justification	Quality of the data and assessment of quality	Audit Conclusion
Internal Risk and rating: 9			
Project Management (Rating: -4)	The audit team assessed the reasons for the risk rating and the steps taken to reduce the risk of the activities which has impact in the project area.	The documents and explanations are provided by the PP in the respective sections of the report and the team found the information is of good quality.	PP has provided enough information for this parameter. Mitigation plan detailed in the section is found satisfactory and hence audit team finds risk rating is appropriate.
Financial Viability (risk rating 0)	The audit team assessed the rationale for the risk rating on the project cash flow breakeven point.	The documentation provided is a financial analysis that allowed for assessment by the audit team and is therefore of good quality.	PP has provided enough information for this parameter. Information provided in the section is found satisfactory and hence audit team finds risk rating is appropriate.
Opportunity cost (risk rating -2)	The audit team evaluated the justification for rating the risk and the mitigation plan detailed in the section.	Project proponent is a for-profit organization. The information provided in this section meets the requirements and is found of good quality.	As mentioned in tool section 2.2.3 (2) Where most baseline activities over the length of the project crediting period are subsistence-driven, an NPV analysis is not required, but an assessment of the net impacts of the project on the social and economic well-being of the communities who derive livelihoods from the project area (see Section 0) shall be undertaken. PP has update the report with satisfactory details about the analysis of

Risk Rating	PP Justification	Quality of the data and assessment of quality	Audit Conclusion
			opportunity cost. Risk rate is appropriate.
Project longevity(risk rating 15)	The audit team evaluated the justification for rating the risk and the mitigation on legal agreement or requirement to continue the management practice.	PP has a legal binding agreement between the partner for a period 30 years. Hence the project longevity is 15. Evidence has been provided of the project ownership (in line with section 3.7.1 (5) of VCS standard v4.4) can be maintained for the entire project longevity i.e., 30 years (agreement between the PP and the project partners). While the agreement between the partners and the land owners are of 10 years renewable and the control is secured through a concession that is shorter than the project longevity, and these concessions are renewable for the full longevity period (section 2.2.4 (2))	Risk rate is appropriate.
External risk rating: 0			
Land Tenure and Resource Access/Impacts Risk rating 0	The audit team evaluated the justification for rating the risk and the mitigation.	The documentation provided is the description and supports on forest and land tenure regulations that allowed for assessment by the audit team and is therefore of good quality.	Risk rate is appropriate.
Community engagement. Risk rating: -5	The audit team evaluated the justification for the risk rating on the consult to the stakeholders associated with the project area.	Documents provided by the PP on the consultations were checked and found of quality. PP has consulted more than 50% of the stakeholders in the project area and more than 20% of the	

Risk Rating	PP Justification	Quality of the data and assessment of quality	Audit Conclusion
		stakeholders outside the project area. Suitable evidence was provided to support the explanation.	
Political Risk: Risk rating: 2	The audit team evaluated the justification for rating the governance risk and the mitigation on planned activities.	The governance score for this project is - 0.470991751. audit team checked the documentation and explanation provided on the mitigation plan and found of good quality.	Risk rate is appropriate.
Natural Risk rating: 1.50			
Fire (Risk rating 0.50)	The audit team evaluated the justification for rating the all the natural risk and the actions of mitigation.	Explanation given by in this section is found satisfactory.	The audit team for an independent analysis of natural risk such as fire, pest & disease outbreaks. Extreme weather and geological risks has used online resources/references /39/, /40/ and /43/ to check the rating claimed for the risk assessment by the PP and found the risk assessment and score appropriate.
Pest and Disease outbreaks (Risk rating 0.50)			
Extreme Weather (Risk rating 0.50)			
Geological Risk (Score 0)			
Overall Risk rating from the report is 11 %			

The calculation has been verified using the VCS tool, which was used to calculate the non-permanence risk. The calculated overall risk rating was %. For the current project activity all the parameters in different risk category are same though project areas are in different regions of Mexico. Therefore, the calculated risk rating will be same for the entire project area. As a result, the value taken into account is according to the suitable tool, and a conservative value has been taken into account for the project. By multiplying the risk factor by the calculated net emission reductions in accordance with the excel calculation sheets, the total tradable VCUs are determined. The risk rating should only be utilized to reserve buffer credits and determine VCUs in accordance with the VCS permanence criteria. The risk will be reassessed at the time of the next verification as per VCS standard as the risk rating may change.

CAR 19 and 69 as raised and resolved successfully. Refer Appendix 2 for the same.

4 VALIDATION OPINION

The project satisfies the VCS project validation and verification standards. The project was designed in line with the project description that had been validated, and any discrepancies were explained.

The audit team concludes that the estimated quantification of the net GHG removals during the validation period is free of major misrepresentation and conforms with the validation requirements. This is done with a fair degree of assurance.

The data and information supporting the GHG statement assertion were historical in nature. The project's baseline, monitoring plan, and the project's compliance with relevant VCS requirements and host Country criteria are validated to confirm that the project design is sound and reasonable and meets the identified criteria and guidelines.

As summary the validation team able to conclude that:

- The monitoring plan is transparent and adequate and in line with applied baseline and monitoring methodology of VM0042, version 1 and AFOLU Non-Permanence Risk Tool v4 to estimate buffer credits as per VCS standard requirement.
- The calculation formulae and use of parameters for the project emission reductions estimation are transparent and in line with the requirement of the applied methodology. The ex-ante projection of emission reductions given is found to be appropriate, conservative and in line with the requirement.
- The conclusions of this report show, that the project, as it was described in the project documentation, is in line with all criteria applicable for the validation as outlined under current VCS Standard.
- The validation process has been conducted by 4KES in accordance with ISO 14064-3:2019, based on all issues and criteria of VCS standards. The conclusions of this report show that the project, as it was described in the project documentation, is in line with all criteria applicable for the validation.

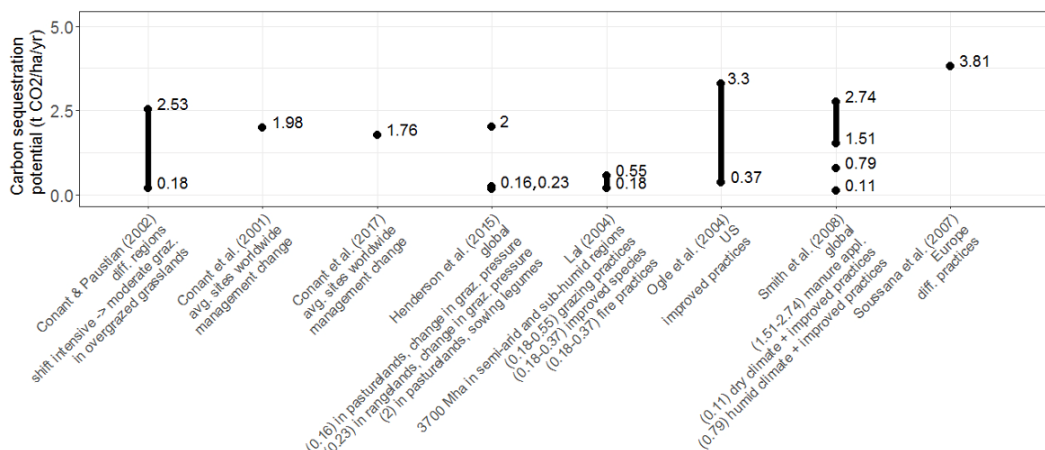
4KES concluded that the PDD and its calculations for expected emissions reduction met all requirements for validation against the VCS standard. The Project activity is found to be eligible under Sectoral Scope 14. As a result, 4KES can conclude that the project satisfies all pertinent requirements of the criteria and recommend that the project activity be registered.

Year	Estimated net GHG emission reductions or removals (tCO ₂ e)
Year 2018	Not applicable
Year 2019	1,275,037
Year 2020	999,661
Year 2021	1,398,426

Year	Estimated net GHG emission reductions or removals (tCO ₂ e)
Year 2022	1,270,186
Year 2023	1,232,893
Year 2024	1,232,893
Year 2025	1,232,893
Year 2026	1,232,893
Year 2027	1,232,893
Year 2028	1,232,893
Year 2029	1,232,893
Year 2030	1,232,893
Year 2031	1,232,893
Year 2032	1,232,893
Year 2033	1,232,893
Year 2034	1,232,893
Year 2035	1,232,893
Year 2036	1,232,893
Year 2037	1,232,893
Year 2038	1,232,893
Total number of crediting years	20
Average annual ERs	1,233,480 (after deducting buffer credit)

PP has revised the areas and has provided revised ER sheet for VVB review. Please see VVB response to point 1 of this PRR finding. PP's control on total area is more than 80% of the total area planned in the 1st instance. PP has provided few secondary references to VVB team with regards to SOC removal rates in grasslands by implementing project activities. One of the articles³², the authors have analysed mean potential soil carbon sequestration values from peer-reviewed studies on regional and global scales and the below image summarises the same.

³² Godde, C.M., de Boer, I.J.M., Ermgassen, E.Z. *et al.* Soil carbon sequestration in grazing systems: managing expectations. *Climatic Change* 161, 385–391 (2020). <https://doi.org/10.1007/s10584-020-02673-x>



The image, from the supplementary text of Godde et al, shows “Estimated annual soil carbon sequestration potential from farming practices change, per hectare” as estimated across several publications. Furthermore, as quoted in Godde et al: “Meta-analyses find that “improved” grazing systems practices tend to lead to soil carbon sequestration, by an average of 1.76 t CO₂ /ha/yr.”

APPENDIX 1: LIST OF DOCUMENTS REFERRED

Ref. No	Title of Document	Version	Date
1	<u>VCS Program Guide</u>	4.3	Updated: 17 January 2023
2	<u>VCS Standard</u>	4.4	Updated: 17 January 2023
3	<u>VCS Validation and Verification Manual</u>	3.2	19 th October 2016
4	<u>VCS Validation report template</u>	4.2	Updated: 21 December 2022
5	<u>AFOLU Non-Permanence Risk Tool</u> (both Excel and template)	4	Issued: 19 September 2019
6	<u>VCS Project Description Template</u>	4.2	Updated: 21 December 2022
7	Final Project Description (PD)	5	01/08/2023
	Revised PD	7	01/05/2024
	Revised PD (VCS PRR R3)	8	20/09/2024
8	Emission Reductions Calculation Spread sheet (final_Mexico_ranches_instance_1_validation_ER Projection. xlsx)	4	NA
	ERR Calculations - Mexico_PRR Comments_r2.xlsx	5	
	ERR Calculations - Mexico_PRR Comments_R3.xlsx	6	

Ref. No	Title of Document	Version	Date
9	VERRA webpage with global consultation (https://registry.terra.org/app/projectDetail/VCS/2887)	NA	NA
10	Project Polygon KMLs	NA	NA
11	Maps showing location of Ranchers	NA	NA
12	SOP	01	NA
13	Website - <u>UN Sustainable Development Goals</u>	NA	NA
14	Final Non-Permanence Risk Analysis Report.doc	02	01/08/2023
15	LULC analysis documents	NA	NA
16	VCS-Risk-Report-Calculation. xlx	NA	NA
17	Land ownership legal documents	NA	NA
18	MoU between the PP and partners	NA	NA
19	Boomitra Inc . Website www.boomitra.com	NA	NA
20	<u>VCS methodology VM0042</u>	1.0	19 th October 2020
21	<u>VMD 0053 Module: Model calibration, validation, and uncertainty guidance for the methodology for improved agricultural land management</u>	01	Active from 19 October 2020 to 29 May 2023
22	Undertaking for double counting, other forms of credit, Jurisdictional REDD+ boundaries, etc.	NA	NA
23	Stakeholder Consultations minutes of meetings, attendance sheets and photographs	NA	NA
24	Mexican Government Law	NA	NA
25	Google earth - https://www.google.com/earth	NA	NA
26	CVs of management team and technical experts and local expert	NA	NA
27	Training records and photographs	NA	NA
28	Baseline assessment excl sheet	NA	NA
29	CarbonFocus Algorithm Theoretical Basis Document (ATBD).	1.2	NA
	Document (ATBD).	1.4	
	Document (ATBD). (DICCIONARIO DE DATOS DE EROSION DEL SUELO.pdf)	1.5	
30	RothC Model documents	NA	NA
31	Start date evidence	NA	NA
32	Grievance Expression Process Book	NA	NA
33	Expert Opinion and credentials of Expert	NA	NA
34	HR policy and Boomitra Ethic policy	NA	NA
35	Employment records	NA	NA
36	Carbon revenue sharing agreements	NA	NA
37	Grassland Management Plans	NA	NA
38	Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities	9.0	CDM-EB50-A30-STAN dated 27 May 2021
39	USGS www.usgs.gov Active Fire Data https://www.earthdata.nasa.gov/learn/find-data/near-real-time/firms/active-fire-data	NA	NA

Ref. No	Title of Document	Version	Date
40	World Bank Climate Change Knowledge Portal https://climateknowledgeportal.worldbank.org/country/mexico/climate-data-historical https://www.worldwildlife.org/places/chihuahuan-desert The Geologic Origin of the Sonoran Desert https://www.desertmuseum.org/books/nhsd_geologic_origin.php Chihuahuan Deserts Ecoregion https://pubs.usgs.gov/pp/1794/a/chapters/pp1794a_chapter27.pdf	NA	NA
41	IRR Analysis	NA	NA
42	Draft model validation report	NA	NA
43	SEGOB Reference on Risk associated with Fire: URL: 2007:https://www.dof.gob.mx/nota_detalle.php?codigo=5077654&fecha=16/01/2009#gsc.tab=0 2022:https://www.dof.gob.mx/nota_detalle.php?codigo=5654871&fecha=13/06/2022#gsc.tab=0		
44	KML Issues Action_Boomitra Grassland Project.docx	NA	NA
45	full end-to-end calculations for one ranch.xlsx Additional documents associated with end-to-end calculation spreadsheet supporting document folder	NA	NA

APPENDIX 2: LIST OF FINDINGS

Table 1. CL from this validation

CL ID	01	Section no.	1.1 of PD	Date: 05/05/2022
Description of CL				
Section 1.1 of the Project Description Template requires the project proponent to include the estimated annual Average along with total estimated emission reduction over the crediting period. Correction requested.				
Project participant response				Date : 01/06/2023
Section 1.1 of the PD has been revised and added the requested information “total estimated emission reduction over the crediting period”.				

Documentation provided by project participant	
Revised PD	
DOE assessment	Date: 07/06/2023
PD has been revised and hence CL is closed.	

CL ID	02	Section no.	1.7 of the PD	Date : 05/05/2022
Description of CL				
- Agreement with implementation partners with Project Proponent to be submitted. - Credit share agreement with Ranchers and Ejido to be submitted, also clarify credit share agreement executed between end users with Project Proponent or implementation partners. Though the document submitted for validation, agreement in Mexican language, share the English translated version to validation team.				
Project participant response				Date : 01/06/2023
- Agreement with implementation partners with Project Proponent has been submitted. - English version of the Credit share agreement has been shared.				
Documentation provided by project participant				
Agreement with implementation partners and English version of the Credit share agreement				
DOE assessment				Date: 07/06/2023
Validation reviewed the documents and found satisfactory and hence CL closed.				

CL	03	Section no.	1.15 of the PD	Date: 05/05/2022
Description of CL				
PP has to submit the declaration for this project instance is neither registered in any other GHG program nor going to register or participate in any other GHG Programs other than VCS.				
Project participant response				Date : 01/06/2023
PP has submitted the declaration for this project instance is neither registered in any other GHG program nor going to register or participate in any other GHG Programs other than VCS.				
Documentation provided by project participant				
Declaration document.				
DOE assessment				Date: 07/06/2023
Validation team reviewed the declaration document and found ok and hence CL is closed.				

CL	04	Section no.	2.4 of the PD	Date: 05/05/2022
Description of CL				
PP has to fill the section 2.4 of the PD appropriately as public commenting period is over at the time of validation. Correction requested				
Project participant response				Date : 01/06/2023
Requested correction has been made in the revised PD.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 07/06/2023
PP has revised the PD with proper justification and hence CL is closed.				

CL	05	Section no.	2.5 of the PD	Date: 05/05/2022
Description of CL				
Submit the proof Grievance Expression Process Book maintained at each implementation partners head office.				
Project participant response				Date : 01/06/2023

Images of Grievance Expression Process Book has been submitted.	
Documentation provided by project participant	
Images of Grievance Expression Process Book	
DOE assessment	Date: 07/06/2023
Copy of the registers has been checked and CL is closed.	

CL ID	06	Section no.	3.3 of the PD	Date: 05/05/2022
Description of CL				
All the states/Location mentioned in the project boundary in section 3.3 of the PD are located within the boundaries of the two deserts mentioned in the PD or Northern Mexican Area. Clarification requested				
Project participant response				Date : 01/06/2023
All the states/Location mentioned in the project boundary in section 3.3 of the PD are located within the boundaries of Northern Mexican Area.				
Documentation provided by project participant				
NA				
DOE assessment				Date: 07/06/2023
CL is closed.				

CL	07	Section no.	3.4 of the PD	Date: 05/05/2022
Description of CL				
Proof to be submitted for “The populations of nearly 20 vertebrate species have been detrimentally affected and the land’s capacity to support livestock has decreased “as described in section 3.4 of the PD.				
Project participant response				Date : 01/06/2023
Cited reference document has been provided for VVB. Same can be downloaded from the location https://www.researchgate.net/profile/Eric-Mellink-2/publication/341383848_Livestock_and_grassland_interrelationship_along_five_centuries_of_ranching_the_semiarid_grasslands_on_the_southern_highlands_of_the_Mexican_Plateau/links/5f7c8ad4a6fdccfd7b4aadce/Livestock-and-grassland-interrelationship-along-five-centuries-of-ranching-the-semiarid-grasslands-on-the-southern-highlands-of-the-Mexican-Plateau.pdf?origin=publication_detail				
Please see the page number 14 of the document.				
Documentation provided by project participant				
2020-5siglosdepastoreoenOjuelos.pdf				
DOE assessment				Date: 07/06/2023
Reference provided by the PP is found appropriate and hence CL is closed.				

CL	08	Section no.	3.4 of the PD	Date: 05/05/2022
Description of CL				
In Section 3.4 of the PD, Figure 27 provides the Boomitra’s rancher recruitment efforts are focused on priorities site in Chihuahuan Desert, what about plan for other desert in the project boundaries How the priority sites have been selected based on this data also submit the proof of the same for review.				
Project participant response				Date : 01/06/2023
The priority sites in the Chihuahuan Desert are selected by the WWF not by PP. However, PP along with its implementation partners are working in these sites along with other ranchers who included here. Ranchers (not part of the present project) who want to adopt new sustainable grazing practices in both deserts are contacted and will included in this project.				
Documentation provided by project participant				

NA	
DOE assessment	Date: 07/06/2023
Justification of PP is found satisfactory and hence CL is closed.	

CL	9	Section no.	ATBD and Section 1.1 of PD	Date: 07/06/2023
Description of CL				
- What is the time (years) required for rotationally grazed ranches to reach an equilibrium SOC stage? What is the peak of such SOC sequestration potential after which the SOC increments would not occur? - There could be differences in total carbon increments across project areas. The estimated ERs may turn out different from the estimates. PP need to clarify on this.				
Project participant response				Date : 20/06/2023
- There is an example provided to this effect in the ATBD last section now, as per the previous comments on that document: the range of SOC in temperate grasslands is typically 0-5wt%, with literature suggesting that the higher end of the spectrum is only achieved in areas with properly managed/'light' grazing (https://www.sciencedirect.com/science/article/pii/S0341816221004938). Hence, in a *natural* temperate grassland system, SOC levels approaching 5% can be considered close to saturation. For the ranch example in the ATBD, currently at 2%, with a 0.055wt% slope of SOC vs years, it would take 55 years to reach 5% assuming the same slope can be maintained. It could take longer as the slope decays as carbon gets higher. (example of calculation : 0.055wt% C * 0.3 m (depth) * 4046m²/acre * 1.2 tons/m³ (bulk density) * 44-ton CO₂eq/12-ton C = 2.94ton CO₂eq/acre). (This is 0.055wt%, or about 2.5-3-ton CO₂eq/acre. wt% is 'weight percentage' of soil organic carbon. In a 100-ton mass of soil, there would be an increase of 5.5 tons of organic Carbon) - Yes, the current estimations at the time of validation is based on the combination of literature data for baseline emission and the project emissions are directly quantified as per the remote sensing approach which has been used for all project participating ranchers. As observed, each ranch will have its own carbon increments based on the activities adopted during the monitoring period. At the time of validation, actual estimations will be reported for each ranch.				
Documentation provided by project participant				
NA				
DOE assessment				Date: 20/07/2023
PPs explanation is satisfactory and hence CL is closed.				

CL	10	Section no.	1.8	Date: 07/06/2023
Description of CL				
- Did PP initiate the activities or are there regional partners that allow these possibilities? PP need to clarify. - Does the start date vary drastically from ranch to ranch? If yes how ERs are estimated. PP need to clarify.				
Project participant response				Date : 20/06/2023
- Boomitra works with ground implementation partners and this project is being implemented with the help of local partners who are working in this region for many years. - Start dates vary from ranch to ranch, and the carbon removal is estimated (at the time of validation) using September 1, 2018 as the base year. However, at the time of verification, carbon removals are calculated based on the actual start dates.				
Documentation provided by project participant				
NA				

DOE assessment	Date: 20/07/2023
PP justification is satisfactory and seems appropriate and hence CL is closed.	

CL	11	Section no.	Description of project activity	Date: 07/06/2023
Description of CL				
PP need to clarify on how exactly the rotational grazing areas are demarcated and held (e.g., fencing, etc. this need to be mentioned in the monitoring plan section of PD.				
Project participant response				Date : 20/06/2023
At present, all the information on paddock demarcation for rotational grazing has been recorded manually in the notebook at the ranch level. It has been planned, with the help of Carbon Finance, to digitize all data collection related to rotational grazing. Many ranchers do not have a permanent fencing system. Wired fences are made temporarily, and these fences are kept moving throughout the year. See section 5.3.10 for more details.				
Documentation provided by project participant				
Revised Monitoring plan section of PD.				
DOE assessment				Date: 20/07/2023
PP justification is satisfactory and seems appropriate and hence CL is closed.				

CL	12	Section no.	3.2	Date: 07/06/2023
Description of CL				
PP need to clarify how relevant (both pros and cons) the model is for ranches and similar applications from published literature. The key is to mention the uncertainties and know-how succinctly.				
Project participant response				Date : 20/06/2023

The RothC model used in this project has been shown to be applicable in grasslands around the world, for various management conditions including continuous grazing (Smith, S. W., Vandenberghe, C., Hastings, A., Johnson, D., Pakeman, R. J., Wal, R. van der, & Woodin, S. J. (2013, December 6). Optimizing carbon storage within a spatially heterogeneous upland grassland through sheep grazing management - ecosystems. SpringerLink. <https://link.springer.com/article/10.1007/s10021-013-9731-7>

and Jebari, A., Álvaro-Fuentes, J., Pardo, G., Almagro, M., & Prado, A. del. (2021). Estimating soil organic carbon changes in managed temperate moist grasslands with Rothc. PLOS ONE. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0256219> ,

and rotational grazing (Bolinder, M. A., Chan, K. Y., Farage, P. K., Janssen, P. H. M., Jeffrey, S. J., Kemmitt, S. J., Lal, R., Lima, A. M. N., Liu, D. L., Moore, A. D., Paul, K. I., Smith, P., Bertora, C., Brumme, R., Chen, G., & Coleman, K. (2011, August 4). Simulation of soil organic carbon dynamics under different pasture managements using the ROTHC carbon model. Geoderma. <https://www.sciencedirect.com/science/article/pii/S0016706111001947>

and Poeplau, C. (2016, August 24). Estimating root: Shoot ratio and soil carbon inputs in temperate grasslands with the ROTHC model - plant and Soil. SpringerLink. <https://link.springer.com/article/10.1007/s11104-016-3017-8>, .

These literature studies suggest that when a RothC model is properly calibrated, the uncertainty in measuring SOC change compared to field trial data is 0.2-0.5-ton CO₂eq/acre/year for each field trial simulation site (in this project, this would constitute each ranch). Given that the net carbon sequestration estimated in this project per acre per year is much higher than this uncertainty threshold (see Sections 4.4.2 and 4.4.3), the uncertainty is expected to be sufficiently low to permit the measurement of the carbon sequestration to statistical significance.

The 0.2-0.5-ton CO₂eq/acre/year is not increments, but rather the *uncertainty* observed in the biogeochemical models presented in the literature when validated against field trial data. This is a similar exercise to what will be presented in the monitoring report (in the model validation report). 0.2-0.5-ton CO₂eq/acre/year corresponds to 0.004-0.009wt% in SOC. The 0.055 is also a weight percent, not a tonnage, so cannot be compared to 0.2-0.5 tons. 0.055wt% is around 2.5-3 tons CO₂eq/acre. In this context, you can see the error for a given would be 0.5 ton/3ton = 16.7% of the increment in a year. Biogeochemical model literature typically gives SOC in terms of tons of carbon stock, but soil science typically considers SOC in wt%. Using the same units is essential for a proper comparison.

Documentation provided by project participant

Revised PD

DOE assessment

Date: 20/07/2023

PPs justification to CL is satisfactory and hence CL is closed.

CL	13	Section no.	3.3	Date: 07/06/2023
Description of CL				
PP need to clarify and describe clearly why biomass increments would be zero. Where would the carbon inputs into the soil come from if not biomass during the resting period? Provide peer-reviewed literature evidence on this.				

Project participant response	Date : 20/06/2023
None of the project activities promoting any activities which increase woody biomass. Due to rotational grazing, biomass of grass does increase and noted here as 'herbage dry matter'. (See the reference: https://www.sciencedirect.com/science/article/pii/S0167880922002249). Hence, the above ground biomass is not included in the carbon pool in the project. Biomass come from whatever the leftover grass after grazing by the cattle and the excreta of the cattle which is the same as the baseline scenario. During the resting period, grass is grown and extra grass has been coming from anywhere.	
Documentation provided by project participant	
Reference: https://www.sciencedirect.com/science/article/pii/S0167880922002249	
DOE assessment	Date: 20/07/2023
PPs justification is satisfactory and hence CL is closed.	

CL	14	Section no.	3.4	Date: 07/06/2023
Description of CL				
In simple terms 'holistic grazing' is the baseline which refers to the grazing of the entire livestock across the ranch. Is there a threshold of grazing density (ranch area available per cattle head) which will lead to degradation? The point here would be that difference in livestock population density would mean a difference in the level of stress there would be on vegetation. There was an analysis of livestock density and ranch size shared earlier. PP need clarify and information on this to enable a better understanding of the project potential in the section.				
Project participant response				Date : 20/06/2023
Each ranch has the management plan where livestock carrying capacity has been evaluated and same has been maintained as part of the project activity. This will be made mandatory in the future instances as well.				
Documentation provided by project participant				
NA				
DOE assessment				Date: 20/07/2023
PPs justification is satisfactory and hence CL is closed.				

CL	15	Section no.	4.4.2	Date: 07/06/2023
Description of CL				
Another primary consideration is equilibrium stock vs transients (model run): If 2.8 tCO ₂ e/ha is lost annually, does this mean the SOC would tend to zero? conversely, under the project scenario, the SOC increments would saturate- thus, considering the equilibrium state, and time to an equilibration (in reality), how the model simulates this is critical. It is ideal to at least present published literature on this if not an actual model validation report. PP need to clarify on this.				
Project participant response				Date : 20/06/2023

RothC has several carbon decay terms that collectively approach an equilibrium over various timescales, depending on the specific soil carbon pool under consideration. Thus, the baseline scenario's RothC model will also have an equilibrium state for a given set of site-specific conditions, if propagated indefinitely, and vice-versa for the project scenario's model. However, the project scenario's model is repeatedly true-upped by using the ex-post soil carbon measurements, so it is not limited by any RothC model specific equilibration constraints. For baseline scenarios, literature suggests that RothC model equilibrium is reached in timescales of 20+ years . The exact level of the equilibrium, as mentioned previously, will depend on the site-specific inputs. Not every ranch will therefore show 2.8tCO₂e loss yearly in the baseline scenario. Rather if the starting soil carbon is already close to the RothC equilibrium for that site's set of condition, the loss might be close to 0.	
Documentation provided by project participant	
Revised PD	
DOE assessment	Date: 20/07/2023
The response is reasonable and satisfactory and hence CL is closed.	

Table 2. CAR from this validation

CAR ID	01	Section no.	1.3 of the PD	Date :05/05/2022
Description of CAR				
The applied methodology VM 0042 Version 2.0 dated 21/12/2021 is still under development as per VCS methodologies portal, validation carried out based on this and request for registration will be submitted based on the approval of the methodology and also PD has to corrected in case of any changes in the applied methodology.				
Project participant response				Date :01/06/2023
VCS has released the version 2 of the methodology. However, we has decided to go with version 1 of the methodology and necessary changes has been made in the revised PD.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date :07/06/2023
Since the PP has used the V1 in the revised, PD CAR is not applicable and hence closed.				

CAR ID	02	Section no.	1.8 of the PD	Date :05/05/2022
Description of CAR				
The start date to be substantiated with proof, the submitted proof i.e., management plans as described in the PD is in Mexican language and provide the English translated documents for verification.				
Project participant response				Date :01/06/2023
English version of sample management plan has been submitted for the validation.				
Documentation provided by project participant				
Management plan of ranches are shared.				
DOE assessment				Date :07/06/2023
Validation team reviewed the management plans and found proper and hence the CAR is closed.				

CAR ID	03	Section no.	1.8 of the PD	Date :05/05/2022
Description of CAR				

It is not clear in section 1.8 of the PD, how the project is going to be implemented for instance 01, Filed Procedures or implementation plan shall be submitted to validation team for review.	
Project participant response	Date :01/06/2023
All the procedures related to the project activity implementation is available in Standard operating procedure (field procedure) mentioned in the SOP within the Management plan document.	
Documentation provided by project participant	
SOP document	
DOE assessment	Date :07/06/2023
Validation team reviewed the documentation and found satisfactory and hence CAR is closed.	

CAR ID	04	Section no.	2.5 of the PD	Date :05/05/2022
Description of CAR				
As per VCS Standard version 4.2, Risks to Local Stakeholders paragraph 3.17.14, In the PD description the following to be included in section 2.5 of the PD” The project proponent or any other entity involved in project design or implementation shall not be involved in any form of discrimination or sexual harassment “. Correction requested.				
Project participant response				Date :01/06/2023
Boomitra and its implementation partners do not involve in any form of discrimination or sexual harassment. Boomitra follows international standards and abides with all local laws when it comes to workforce and other sensitive aspects of project. We ensure an inclusive working environment free of discrimination at all stages of the employment life cycle, promote and create plans to allow different cultures to thrive by a providing conducive environment to flourish. Boomitra has signed an agreement with implementation partners. Agreement clearly specifies they have to follow the Boomitra Ethic policies and shall not indulge in any of the discrimination or sexual harassment.				
Section 2.5 has been revised with requested correction.				
Documentation provided by project participant				
Revised PD, Agreements with partners, Boomitra Ethic guidelines document.				
DOE assessment				Date :07/06/2023
Revised PD has been checked and found satisfactory and hence CAR closed.				

CAR ID	05	Section no.	3.2 of the PD	Date :05/05/2022
Description of CAR				
In section 3.2 of the PD, the applicability conditions described is incomplete w.r.t to the applied methodology applicability conditions. Correction requested in this context.				
Project participant response				Date :01/06/2023
All the applicability conditions described in the methodology are now covered in the revised PDD				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date :07/06/2023
Revised PD has been checked and found satisfactory and hence CAR closed.				

CAR ID	06	Section no.	3.2 of the PD	Date :05/05/2022
Description of CAR				
How PP would ensure that project land will be remains cropland or grassland throughout the project crediting period. It may change at any time during the crediting period, proper justification required in this context				
Project participant response				Date :01/06/2023

LULC analysis has been done each individual ranchers and found that they remained grasslands. This project does not promote or allow any land use change during the crediting period. This will be confirmed before each verification and reported in the respective monitoring report and at the same time agreements are signed with ranchers with regard to this. Capacity building programs are planned and ranchers will be given training on how the grasslands are better managed with sustainable grazing practices, future carbon finance will be utilized to make sure that the project lands to remain as grasslands.	
Documentation provided by project participant	
NA	
DOE assessment	Date :07/06/2023
Revised PD has been checked and found satisfactory and hence CAR closed.	

CAR ID	07	Section no.	3.2 of the PD	Date :05/05/2022
Description of CAR				
In applicability conditions 04, the PP has showed the literature study in Texas in US to substantiate no statistically significant effects on harvest efficiency from the livestock. Clarify how these studies are applicable for this project region also submit the proof for the same to validation team.				
Project participant response				Date :01/06/2023
During the interactions with the ranchers, we have received the opinion that there no significant changes in the productivity. There are various studies conducted at different grasslands and suggests that productivity and sustainability may be compatible by replacing continuous with rotational grazing.				
This will be confirmed during the verification stage.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date :07/06/2023
PP justification found satisfactory and hence CAR closed.				

CAR	8	Section no.	3.4 of the PD	Date :05/05/2022
Description of CAR				
Submit baseline study conducted by the Boomitra to validation team to substantiate the baseline scenario claimed in the PD.				
Project participant response				Date :01/06/2023
Baseline excel sheet has been provided for review.				
Documentation provided by project participant				
Mexico_rancher_Baseline_Info_CTR.xls				
DOE assessment				Date :07/06/2023
Report has been checked and found satisfactory and CAR closed.				

CAR	9	Section no.	3.4 of the PD	Date :05/05/2022
Description of CAR				
As per statement provided in section 3.4 of the PD, How the baseline SOC Stocks measured based on the methodology shall be provided to Validation team for review				
Project participant response				Date :01/06/2023
We have changed the approach hence this CAR is not applicable.				
Documentation provided by project participant				
NA				
DOE assessment				Date :07/06/2023

This CAR is not applicable since PP has changed the version of Methodology and hence CAR is closed. However, more CARs were raised on CarbonFocus ATBD-Mexico.docx that are listed below.

CAR	10	Section no.	3.4 of the PD	Date :05/05/2022
Description of CAR				
As per VCS Standard 4.2, Section 3.8 the Crediting period is 20 years and which may be renewed at most four times for AFLOU projects where in section 3.4 of the PD states that the baseline shall be updated every 10 years in accordance with Section 3.8 of the VCS Requirements on renewal of baselines which is contradicting. Clarification requested				
Project participant response				Date :01/06/2023
As per the VCS standard 4.4, the minimum crediting period is 20 years. However, the methodology requirement (section 9.3 Description of monitoring plan) is that the baseline shall be updated every 10 years. Hence the PD states that the baseline shall be updated every 10 years.				
Documentation provided by project participant				
NA				
DOE assessment				Date :07/06/2023
PP justification is found to be in line with VCS requirement and hence CAR is closed.				

CAR	11	Section no.	3.4 of the PD	Date :05/05/2022
Description of CAR				
In section 3.4 of the PD, PP has to explain how the values has been arrived in the tables for land use and land changes of the project location before the project implementation based on LULC analysis. Further why the analysis carried out in entire Mexican region not in the project priority sites since the project start date is in the year 2018 of the project activity. Correction requested.				
Project participant response				Date :01/06/2023
The LULC analysis has been done to demonstrate the grasslands are decreasing year by year. However, the individual rancher wise LULC analysis has been done and provided for the review.				
Documentation provided by project participant				
Ranch_landsat_images_2007-2021 folder				
DOE assessment				Date :07/06/2023
Validation team has checked the information provided and hence CAR closed.				

CAR	12	Section no.	3.5 of the PD	Date :05/05/2022
Description of CAR				
The barriers mentioned in additionality section 3.5 of the PD are generic, why they have not adopted the rotational grazing practice in pre project scenario, how these barriers are preventing the project implemented by the PP to be explained as per barriers mentioned in the methodology additionality section like traditional equipment and technology Barriers associated with whether growers believe they can feasibly adopt new practices, implications of decisions, and their attitudes towards risk etc. Correction requested				
Project participant response				Date :01/06/2023
Justification has been provided in the same section how these barriers are preventing ranchers to adopt to new practices.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date :07/06/2023
Revised PD has been checked and found the justification satisfactory and hence CAR closed.				

CAR	13	Section no.	3.5 of the PD	Date :05/05/2022
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Description of CAR	
Common practice is authenticated with proof of expert opinion in section 3.5 of the PD, confirm expert from which field e.g., agricultural extension agent, accredited agronomist or qualified local expert Qualification of the expert to be proved by the PP, there is no details provided in the submitted documents	
Project participant response	Date :01/06/2023
Dr Adrián-Raymundo Quero-Carrillo is research Professor. He is a POSTDOCTORATE from UNIVERSITÉ DE MONTREAL. BIOTECHNOLOGY. 2004-2005 and has obtained Doctorate from UNIVERSIDAD DE TEXASA&M. COLLEGE STATION, TEXAS, ESTADOS UNIDOS.1999 on the subject SOIL AND CROP SCIENCES, He has been working in the Mexican grasslands for more than 40 years. He is well known research scholar and has published many papers on the grasses and grasslands of Mexico. Detailed CV and his works are provided for VVB review.	
Documentation provided by project participant	
QueroAdrianResume.pdf Adrian Raymundo Quero Carrillo.pdf	
DOE assessment	Date :07/06/2023
Competency of the expert has been checked and found satisfactory and CAR closed.	

CAR	14	Section no.	3.5 of the PD	Date :05/05/2022
Description of CAR				
From the Expert opinion "it states that as per Ley de Asociaciones Ganaderas. (Law of cattle association) the ranchers to adopt the sustainable grazing practice. As it is mandated by the Law and expert opinion then how project become additional? Clarification requested				
Project participant response				Date :01/06/2023
As expert mentioned in his opinion document, the above said law is just on the paper and never been implemented on the ground. Also, the law do not mandate ranchers to adopt sustainable grazing practices instead it asks ranchers to join the association.				
Also summary of the law can be found in the following link https://mexico.justia.com/federales/leyes/ley-de-organizaciones-ganaderas/titulo-ii/capitulo-ii/ .				
Documentation provided by project participant				
English version of the LAW has been provided.				
DOE assessment				Date :07/06/2023
Justification and opinion found satisfactory and hence CAR closed.				

CAR	15	Section no.	4.1 of the PD	Date :05/05/2022
Description of CAR				
Details of control sites (representative sampling of the control sites and the comply with the similarity criteria listed in Table 7 of the applied methodology shall be part of the PD. Details and procedures to be provided DOE for assessment of the same. Correction requested.				
Project participant response				Date :01/06/2023
We have changed the approach hence this CAR is not applicable.				
Documentation provided by project participant				
NA				
DOE assessment				Date :07/06/2023
PP has changed the version of the methodology where there is no requirement of baseline control sites and hence CAR closed.				

CAR	16	Section no.	4.1 of the PD	Date :05/05/2022
Description of CAR				
As per Section 4.1 of the PD, SOC in baseline is calculated based on the on an equivalent soil mass (ESM) basis where section 3.4 of the PD states that directly measured using remote sensing technology. Clarification requested				
Project participant response				Date :01/06/2023
The equivalent soil mass basis is a general framework for representing the final soil carbon stock, and not necessarily predicated on following any single measurement method. For clarification that the methodology also views the notion of ESM in a similar manner, one may refer to Section 8.3 of the methodology, under Quantification Approach 2, where it says that soil carbon stocks are “calculated on an equivalent soil mass (ESM) basis by multiplication with the soil organic carbon content as in each sample unit or stratum at time t-1 directly measured in each sample field. When bulk density is measured in a fixed depth approach, mass corrections can be applied to meet the ESM requirement.” Our method, using remote sensing for direct measurement, is essentially a fixed depth approach since the system is calibrated using soil samples taken from fixed depths. Thus in accordance with the methodology, we may use mass corrections to meet the ESM requirement, and this is what we do. Since we have changed the version of the methodology, there is a change in the calculation process which has been updated in the CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx. We use conservative corrections, derived and detailed in the CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx document in Section 4.1.8, in combination with our fixed depth measurement..				
Documentation provided by project participant				
CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx				
DOE assessment				Date :07/06/2023
PP has changed the version of the methodology and justification provided by the PP is satisfactory. Hence the CAR is closed.				

CAR	17	Section no.	4.1 & 4.4.1 of the PD	Date :05/05/2022
Description of CAR				
The specific measurement approach is available in depth in the accompanying CarbonFocus algorithm Theoretical Basis Document to be submitted to validation team for calculation of baseline emission and project emission. Further how this approach is in line with measurement procedure other potential emerging proximal sensing technologies as listed in Table 9 of in the Appendix 4 to measure SOC stock in the project scenario. clarification requested in this context.				
Project participant response				Date :01/06/2023

The CarbonFocus ATBD document and its supplementary files are to be studied together with the example calculations spreadsheet for a full understanding of the flow of the calculation to the baseline and project emissions.

This method is not considered a specific type of proximal sensing, since it is remote sensing. Thus the measurement procedures are not necessarily identical to those in Table 9. According to Appendix 4, "This appendix provides guidance on requirements for using such emerging technologies and a non-exhaustive list of potential technologies (with a focus on proximal sensing) to determine SOC content and criteria to ensure their robustness and reliability. The applicability of a selected technology to measure SOC in a project must be demonstrated in several peer-reviewed scientific articles. In particular, project proponents should provide evidence of the ability of an emerging technology to predict SOC content with sufficient accuracy through the development and application of adequate calibration with data obtained from classical laboratory methods, such as dry combustion."

Since we have changed the version of the methodology, there is a change in the calculation process which has been updated in the CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx.

For example, comparisons may be made with the suggestions for infrared spectroscopy: our method also involves 1) calibration of machine learning with site specific libraries with local soil samples 2) Subsetting of data to specific regions of interest for the project 3) Full calibration procedure documentation provided to the VVB.

Documentation provided by project participant

CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx.

DOE assessment

Date :07/06/2023

PP has changed the version of the methodology and hence CAR closed.

CAR	18	Section no.	4.4.2 of the PD	Date :05/05/2022
Description of CAR				
In section 4.4.2 of the PD, the table provides the estimated emission reductions during the crediting period, however How it was estimated as per equations or assumptions as per methodology is not clear in the submitted ER sheet. Correction requested				
Project participant response				Date :01/06/2023
Since we have changed the version of the methodology, there is a change in the calculation process which has been updated in the CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx.				
Documentation provided by project participant				
CarbonFocus ATBD-Mexico_CONFIDENTIAL.docx.				
DOE assessment				Date :07/06/2023
PP has changed the version of the methodology and hence CAR closed.				

CAR	19	Section no.	4.4.2 of the PD	Date :05/05/2022
Description of CAR				
The number of Verified Carbon Units (VCU) as per section 7 of the applied methodology calculation approach is completely missing in the PD and also submit the non-permanence risk report in accordance with the VCS Program document AFOLU Non-Permanence Risk Tool to the validation team. Correction requested.				
Project participant response				Date :01/06/2023
Detailed AFOLU Non-Permanence Risk Tool has been provided for VVB for review. Buffer VCUs are deducted from the gross VCUs and net VCUs are reported in the revised PD.				
Documentation provided by project participant				
VCS-Non-Permanence-Risk-Report-Mexico_grasslands				

DOE assessment	Date :07/06/2023
Documents submitted PP has been checked and found satisfactory and CAR closed.	

CAR	20	Section no.	5.2 of the PD	Date :05/05/2022
Description of CAR				
The measurement method and procedures applied for the following parameters is not in line with procedure mentioned in the applied. Correction requested				
- Areal-average soil organic carbon stocks in the baseline scenario for sample unit i in year t methodology. - Areal-average soil organic carbon stocks in the project scenario for sample unit i in year - Soil mass in one sample depth layer - Inside diameter of probe or auger - Number of cores sampled - Organic carbon concentration in each sample - Average emission reductions from pool or source • , or stock of pool • , in year t				
Project participant response				Date :01/06/2023
Explanation on measurement method and procedures applied for the above parameters mentioned has been provided in the revised PD.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date :07/06/2023
PP has changed the version of the methodology where there is no requirement of certain parameter listed above. However few parameters are still present in the used versions and those parameters are checked for more explanation in the revised and found satisfactory and hence CAR closed.				

CAR	21	Section no.	1.13	Date: 07/06/2023
Description of CAR				
Data related weather is not clear. Clarify why the rainfall and temperature data has not been presented?				
Project participant response				Date : 20/06/2023
Data on rainfall and temperature has been provided in the revised PD				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 20/07/2023
PP has provided proper information and found satisfactory and hence CAR closed.				

CAR	22	Section no.	CarbonFocus ATBD-Mexico_CONFIDENTIAL.doc	Date: 07/06/2023
Description of CAR				

1. Clarify on the details of the spatial resolution of the images used in the overall analysis. This is not available. 2. PP should confirm that whether there will be validation data collected to support the remote-sensed estimates of BD and SOC 3. Reproduction of the processes and data shared in the document shows that soil organic carbon weight percentages measured by the remote sensing technology for validation data tend to generally be over-estimates at the lower end of the range of soil organic carbon values and likewise tend to be under-estimates in the higher end of the soil carbon value range. The same is also observed, albeit to a lesser extent, in the bulk density validation data. Thus the slope of the measured versus observed soil carbon trend is statistically significant but tends to be less than 1. Clarification requested from PP on how these points are to be conceptualized and accounted for within requirements of methodology and VCS Standard.	
Project participant response	Date : 20/06/2023
1. The spatial resolution of the images used is 10 meters on average. [1] 2. Validation data will be collected on the ranches in the region to support validation of the remote-sensed estimates of bd & soc, and will be provided for analysis at the time of 1 st verification 3. A model that underestimates at higher ranges and over-estimates at lower ranges is 1) a natural occurrence in most machine learning systems because 100% of variation can never be described by a model, because perfection is not possible in agriculture/grazing, thus the ML tries to catch most of the variation and 2) the fact that it is this kind of an under/overestimate with slope under 1 leads to an inherently conservative credit estimation. Credits are guaranteed to be conservatively calculated as required by VCS standard [1] https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-2_overview ; https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/overview/mission-summary	
Documentation provided by project participant	
Revised ATBD document	
DOE assessment	Date: 20/07/2023
Revised ATBD document has been checked and found satisfactory and hence CAR closed.	

CAR	23	Section no.	PD	Date: 07/06/2023
Description of CAR				
1. Individual pixel-level predictions made by the remote sensing technology have noticeable uncertainty. Clarification requested on how changes in soil carbon stock due to project activities can be measured in across monitoring periods, given the pixel-level uncertainty. 2. Mention the total project area and what is the per unit area emission reduction? 3. Is there uniform impact of foraging across different plant species, reducing the chance of promoting potentially invasive plant species that increase in the presence of continuous grazing. PP need to clarify 4. Information on total annual rainfall, groundwater level, etc is not clear in the PD 5. It's not clear on the following: a. What happens when unsuitable ranches are sold as they cannot be used for grazing b. People who buy the land convert the grasslands to croplands – leading to loss of vegetation and soil carbon loss				
Project participant response				Date : 20/06/2023

1. The normal probability plot, which shows a linear line, meaning that the uncertainty across multiple data points itself follows a normal distribution, and averaging ("sampling") across all pixels within a ranch or the whole project area significantly reduces uncertainty by a factor of approximately $1/\sqrt{N}$ etc. Thus, even if individual pixel measurements are noticeable uncertainty, as long as the slope is seen to be significant (which it's), we will have low uncertainty in the final averaged result across the millions of pixels.	
2. Total area and per unit emission has been provided in the revised PD	
3. There is a uniform impact when the livestock are restricted to a given paddock. This ensures that all species, both invasive and non-invasive species, are equally foraged, and it reduces the chances of invasive species propagating in the project area	
4. Information on total annual rainfall, groundwater level, etc has been provided in the revised PD.	
5. If someone buys a ranch, it does not automatically imply conversion into croplands. Many purchasers make purchases to continue maintaining a livestock operation. Only some purchasers may convert to cropland uses. When they do, they plow up the grasslands, which causes severe soil disturbance, and thus loss of soil carbon. However, only ranches with soil carbon to begin with have the potential to lose it from conversion. Unsuitable ranches that have low soil carbon due to degradation do not lose as much from conversion, but they lose the potential to dramatically increase soil carbon through better grassland management.	
Documentation provided by project participant	
Revised PD	
DOE assessment	Date: 20/07/2023
PPs justification and revised PD has been checked and found satisfactory and hence CAR closed.	

CAR	24	Section no.	ATBD document	Date: 07/06/2023
Description of CAR				
Provide references and justification from literature for such a period. This might affect the ex-ante projections which are not critical; however, since the PP is going to measure actual stocks or each verification, this might not be a problem. However, requested PP to add more information.				
Project participant response				Date : 20/06/2023
Yes, we are measuring actual stocks so nothing is ex-ante.				
There is an example provided to this effect in the ATBD last section now, as per the previous comments on that document: the range of SOC in temperate grasslands is typically 0-5wt%, with literature suggesting that the higher end of the spectrum is only achieved in areas with properly managed/'light' grazing (https://www.sciencedirect.com/science/article/pii/S0341816221004938).				
Hence, in a *natural* temperate grassland system, SOC levels approaching 5% can be considered close to saturation.				
For the ranch example in the ATBD, currently at 2%, with a 0.055wt% slope of SOC vs years, it would take 55 years to reach 5% assuming the same slope can be maintained. It could take longer as the slope decays as carbon gets higher.				
Documentation provided by project participant				
(https://www.sciencedirect.com/science/article/pii/S0341816221004938).				
DOE assessment				Date: 20/07/2023
Team has cross checked the references provided by the PP and found satisfactory and hence CAR closed.				

CAR	25	Section no.	1.3	Date: 07/06/2023
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Description of CAR	
Refer to the appropriate version of the methodology in the footnote.	
Project participant response	Date : 20/06/2023
Appropriate methodology version has been corrected in the PD.	
Documentation provided by project participant	
Revised PD	
DOE assessment	Date: 20/07/2023
PP corrected the foot note and CAR is closed.	

CAR	26	Section no.	1.7	Date: 07/06/2023
Description of CAR				
1. What proportion of the project area is privately owned? The documentation for both cases is distinct and important and hence PP need to mention the details of the same.				
2. Who will implement the project under the community ownership category?				
3. Who and how will the carbon revenue be shared with the communities as compared to private land - owning participants?				
Project participant response				Date : 20/06/2023
1. Details like number of ranches which are private, and community owned along with acreage has been added in the PD. Complete details like name, area, and other information is available in the ER excel sheet.				
2. Details of the implementation has been provided in the same sections.				
3. "Ejido Council" that governs the community will manage the carbon finance. This has been discussed in the carbon agreement. Please see the carbon agreements shared.				
Documentation provided by project participant				
Revised PD and ER excel sheet				
DOE assessment				Date : 20/07/2023
Validation checked the revised PD, carbon agreements and excel sheet and found information is satisfactory and hence CAR closed.				

CAR	27	Section no.	PD Document	Date : 07/06/2023
Description of CAR				
Check and correct the footnote references styles across the PD document.				
Project participant response				Date : 20/06/2023
Footnote style has been checked and consistency is maintained across the PD document				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date : 20/07/2023
PP has revised the footnote styles and hence CAR is closed.				

CAR	28	Section no.	3.1	Date: 07/06/2023
Description of CAR				
Footnote 45; please refer to correct VMD0053 version.				
Project participant response				Date : 20/06/2023
Footnote has been revised and corrected version of VMD0053 has been referred.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 20/07/2023
PP has revised the footnote and CAR is closed.				

CAR	29	Section no.	3.4	Date: 07/06/2023
Description of CAR				
Provide details and data on how at the site level RothC models would be run. Add literature evidence on model validation for the site or similar comparable scenarios.				
Project participant response				Date : 20/06/2023
Details and data on site level RothC are provided in the modeling plan section within the monitoring plan. Literature on comparable scenarios (rangelands/grasslands continuous vs rotational grazing) is provided in Section 3.2 now, along with uncertainties found in those literature. The model has not been validated yet for the specific project sites.				
Documentation provided by project participant				
NA				
DOE assessment				Date: 20/07/2023
This CAR is closed in this validation. However, FAR 01 is raised since the model validation report is not available.				

CAR	30	Section no.	4.1	Date: 07/06/2023
Description of CAR				
In the figure at the end of this section and in the text, mention SOC in consistent units (tCO ₂ e)				
Project participant response				Date : 20/06/2023
Proper units are mentioned in the revised PD.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 20/07/2023
Team checked the revised PD and found appropriate and hence CAR closed.				

CAR	31	Section no.	4.3.1	Date: 07/06/2023
Description of CAR				
Requested PP to note that the uncertainty estimation for RothC-based baseline estimation is more critical than the area re-related uncertainty. Consider providing due emphasis in subsequent validation submissions.				
Project participant response				Date : 20/06/2023
This will be emphasized in the Model Validation Report which will be available at the verification audit.				
Documentation provided by project participant				
NA				
DOE assessment				Date: 20/07/2023
This CAR is closed in this validation. However, FAR 01 is raised since the model validation report is not available.				

CAR	32	Section no.	4.4.1	Date: 07/06/2023
Description of CAR				
Mention clearly that the technology being used to estimate SOC increments has not been established as yet through peer-reviewed publication. This also implies that PP should provide more emphasis on estimating uncertainties rigorously and clearly especially for SOC estimation compared against standard approaches with known uncertainty (refer to detailed comments on ATBD). Additionally, PP is encouraged to provide published literature references or similar or comparable technologies to get a sense of uncertainty estimates. This needs to be added to ATBD as well.				
Project participant response				Date : 20/06/2023
The technology being used to estimate SOC increments has not been established as yet through peer-reviewed publication. However, it is comparable in some ways to other recent literature on measuring soil carbon through remote sensing. (please see the following references)				
A. (Heuvelink, G., Angelini, M., Poggio, L., Bai, Z., Batjes, N., van den Bosch, R., Bossio, D., Estella, S., Lehmann, J., Olmedo, G. and Sanderman, J., 2020. Machine learning in space and time for modelling soil organic carbon change. European Journal of Soil Science,. B. MapBiomass, 2023, "Mapeamento anual do estoque de carbono orgânico do solo no Brasil 1985 - 2021 (coleção beta)", https://doi.org/10.58053/MapBiomass/DHAYLZ, MapBiomass Data, V1" C. Hengl, T., Miller, M.A.E., Križan, J. et al. African soil properties and nutrients mapped at 30 m spatial resolution using two-scale ensemble machine learning. Sci Rep 11, 6130 (2021). https://doi.org/10.1038/s41598-021-85639-y				
ATBD document is also updated with the above information.				
Documentation provided by project participant				
Revised ATBD document.				
DOE assessment				Date: 20/07/2023
This CAR is closed in this validation. However, FAR 02 is raised since the model validation report is not available.				
DOE Assessment				Date 10-01-2024
See FAR 02 assessment for how this CAR has been addressed.				

CAR	33	Section no.	4.4.2	Date: 07/06/2023
Description of CAR				
PP is requested to run multiple examples of SOC stocks under baseline scenarios to establish the variance that could arise due to variations in management ranches (different model scenarios). An estimate of model sensitivity to such changes would then provide a better comprehension to the arguments presented.				
Project participant response				Date : 20/06/2023
As detailed in the modeling plan within the monitoring plan, the model baseline scenario is related to the level of livestock stocking density, and the business-as-usual continuous grazing, alongside the usual RothC inputs (weather etc.). These factors will lead to variance in baseline emissions estimations. These variations will be presented once the RothC model used in this work is validated at the time of verification.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 20/07/2023
This CAR is closed in this validation. However, FAR 01 is raised since the model validation report is not available.				

CAR	34	Section no.	4.4.3	Date: 07/06/2023
Description of CAR				
Please ensure the data required for model validation and calibration is collected with sufficient frequency (VMD0053 needs are met).				
Project participant response				Date : 20/06/2023
This is detailed in Table 5. Dynamic parameters are collected on a monthly basis for model propagation.				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 20/07/2023
Team checked the revised PD and found appropriate and hence CAR closed.				

CAR	35	Section no.	5.1	Date: 07/06/2023
Description of CAR				
DPM/RPM: Add reference to RothC article and relevant table number.				
Project participant response				Date : 20/06/2023
The number is given in the first paragraph of page 9 of the official RothC documentation here: https://www.rothamsted.ac.uk/sites/default/files/RothC_guide_WIN.pdf				
Documentation provided by project participant				
Revised PD				
DOE assessment				Date: 20/07/2023
Team checked the revised PD and found appropriate and hence CAR closed.				

CAR	36	Section no.	5.3.11 (now 5.3.12)	Date: 07/06/2023
Description of CAR				
This section can instead benefit from describing the high-level plan or how model calibration and validation would be done. Requested PP to add text on how steady state would be determined.				
Project participant response				Date : 20/06/2023
Steady state is determined by the model after its calibration, through the site specific model input parameters that exist for each ranch. The modeling section will be revised to the following:				
The RothC model is chosen for this project. RothC has been shown to be applicable in grasslands around the world, for various management conditions including continuous grazing , and rotational grazing . . Several peer-reviewed field trial datasets exist for the proper validation of the model within the climate zones and soil textures found in this project. The baseline conditions include continuous grazing in native grasslands, and these are well represented in the potential model validation datasets available. Furthermore, the number of livestock present on each ranch at the start date of activities on that ranch is collected and attested by each participating rancher, which is the necessary information required from the rancher to successfully initiate the model. Livestock numbers are also monitored yearly from the ranchers. The other required input variables are either acquired from the literature or publicly available datasets, as noted in Table 5. Data from the field trials in literature are aggregated, along with the necessary model input parameters, to form a calibration/validation dataset. The calibration set is used to calibrate the RothC model for the plant residue input parameter. This calibration is done through what is known as a RothC model run in 'inverse', where the field trial data is simulated backwards from the final SOC levels to arrive at what should be the plant residue input parameter to match the given SOC change in the field trial, and this approach is commonly employed in the literature . Furthermore, to provide the plant residue input parameter with generalizability to different farm-specific vegetation conditions, it is also				

planned for it to be fitted with the livestock stocking rate (higher stocking rates are related to lower plant residue input), net primary productivity (higher biomass production leads to more carbon input) and other parameters as explanatory variables. Thus, the final RothC model run for each ranch in the project will take in a plant residue input parameter that is affected by the livestock level and ranch vegetation productivity, among other parameters, allowing for the proper discrimination of different ranch-specific scenarios in the project. (Note that the RothC manure parameter is also affected by the level of livestock as detailed in Table 5, as livestock levels are directly proportional to manure input). Full details of the modeling approach will be provided in the Model Validation Report. Finally, once calibrated and validated as per VMD53, site specific parameters for each ranch and its scenario are entered into the RothC model and it is run forward in time from the start date of the given ranch to the end of the current monitoring period to estimate the resulting ranch-specific baseline emissions.

Documentation provided by project participant

Smith, S. W., Vandenbergh, C., Hastings, A., Johnson, D., Pakeman, R. J., Wal, R. van der, & Woodin, S. J. (2013, December 6). Optimizing carbon storage within a spatially heterogeneous upland grassland through sheep grazing management - ecosystems. SpringerLink. <https://link.springer.com/article/10.1007/s10021-013-9731-7>

Jebari, A., Álvaro-Fuentes, J., Pardo, G., Almagro, M., & Prado, A. del. (n.d.). Estimating soil organic carbon changes in managed temperate moist grasslands with Rothc. PLOS ONE. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0256219>

Author links open overlay panelDe Li Liu a c, a, c, b, AbstractRecently, Bolinder, M. A., Chan, K. Y., Farage, P. K., Janssen, P. H. M., Jeffrey, S. J., Kemmitt, S. J., Lal, R., Lima, A. M. N., Liu, D. L., Moore, A. D., Paul, K. I., Smith, P., Bertora, C., Brumme, R., ... Coleman, K. (2011, August 4). Simulation of soil organic carbon dynamics under different pasture managements using the ROTHC carbon model. Geoderma. <https://www.sciencedirect.com/science/article/pii/S0016706111001947>

Poeplau, C. (2016, August 24). Estimating root: Shoot ratio and soil carbon inputs in temperate grasslands with the ROTHC model - plant and Soil. SpringerLink. <https://link.springer.com/article/10.1007/s11104-016-3017-8>

Ryan C. Byrnes, Danny J. Eastburn, Kenneth W. Tate, & Leslie M. Roche. (2018). Journal of Environmental Quality - ACSESS - Wiley Online Library. <https://acsess.onlinelibrary.wiley.com/doi/abs/10.2134/jeq2017.08.0313>

M. Abdalla, A. Hastings, & D.R. Chadwick. (2017, November 6). Critical review of the impacts of grazing intensity on soil organic carbon storage and other soil quality indicators in extensively managed grasslands. Agriculture, Ecosystems & Environment. <https://www.sciencedirect.com/science/article/pii/S0167880917304693>

https://www.rothamsted.ac.uk/sites/default/files/RothC_guide_WIN.pdf

Jebari, A., Álvaro-Fuentes, J., Pardo, G., Almagro, M., & Prado, A. del. (n.d.). Estimating soil organic carbon changes in managed temperate moist grasslands with Rothc. PLOS ONE. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0256219>

GONZÁLEZ-MOLINA, L., ETCHEVERS-BARRA, J., PAZ-PELLAT, F., DÍAZ-SOLIS, H., FUENTES-PONCE, M., COVALEDA-OCÓN, S., & PANDO-MORENO, M. (2011). Performance of the RothC-26.3 model in short-term experiments in Mexican sites and systems. The Journal of Agricultural Science, 149(4), 415-425. doi:10.1017/S0021859611000232

DOE assessment

Date: 20/07/2023

Looks reasonable and hence CAR is closed in this validation. However, FAR 01 is raised since the model validation report is not available.

ATBD document findings

CAR	37	Section no.	Introduction	Date: 07/06/2023
Description of CAR				
Introduction section first paragraph: the text needs to be carefully refined to indicate that it is the sampling procedure that has errors and not the analytical methods. Thus, the technology in essence reduces the random error of drawing a large number of soil samples and reduces uncertainty. The last part of this paragraph presents a case where intensive sampling is required - this however is not very credible unless a sense of the extent of scale is provided in the argument. For example, what is the				

area that puts forwards 100+ samples or a 1% increment, a 0.5% organic carbon soil would gain 0.005% which is smaller than the least count of the dry combustion method of 0.01%. Thus further assumes sampling uncertainty to be zero (which is never the case). Thus, the claim is not justifiable. I recommend refining this and putting this objectively. On the contrary, if inherently the soil carbon stock measurements using conventional methods are at best 0.01% (assuming zero sampling uncertainty), how can a new method benchmark itself claiming higher than the best standard method being compared?

Project participant response

Date : 20/06/2023

We have revised the section to incorporate soil sampling errors along with a very high level revenue vs cost analysis.: Soil organic carbon stocks have traditionally been measured through soil sampling followed by laboratory testing. The inherent process of going from the field to the calculated soil carbon value has several drawbacks, ranging from the monetary expense to uncertainties accumulated at each step (soil collection at site, transport to the lab, methods used for estimation, etc.). Soil sampling protocols have to be carried out by trained professionals in order to minimize errors that lead to misrepresentation of the lab analysis results. Furthermore, even if the sampling is carried out correctly, different labs can give differing soil property values for a soil analysis on the same sample[1]. This may be due to a lack of standardization in the specific methodologies employed for quantify soil carbon, or due to general random errors in the characterization process itself. The errors typically recorded are often as large as 0.10 wt% for a Walkley-Black (wet chemistry) soil test or at least 0.01wt% for dry combustion followed by gas analysis[2]. Furthermore, soil carbon itself varies even every few meters on a farm, resulting in sampling error from choosing specific locations to take sample cores. This variation can be as high as 0.1wt%, if not more[3]. On the other hand, the yearly increase in soil organic carbon from good practices may be as small as 0.7 ton CO₂ per acre, or about 0.01wt%[4]. Thus, a large amount of sampling on a field level is required to reduce random errors to the point where such a change can be observed. Assuming independent measurements and a statistical normal distribution of results, 100+ soil samples would be needed from a field to see a relative soil carbon increase under 0.01%, assuming that 0.01wt% is the error of a single test, and 0.1wt% in field level variation. Typically, physical soil sampling may only be done every 2.5[5] to 40[6] acres, so taking 100 soil samples would occur across 250 to 4000 acres (assuming, conservatively, that it is a continuous field with just 0.1wt% in SOC variation; considering multiple fields would only contribute more variation). This level of testing is impractical, given that a single laboratory soil test can cost \$100+ in a developed country[7] and \$20+ in a developing country[8]. For 4000 acres, 0.7 tons CO₂/acre and a \$10/ton carbon price (which is itself optimistic in today's markets[9]), the project then generates \$28,000 in revenue but over \$20,000 (and potentially over \$100,000 in a developed country) in just soil testing costs. Thus, the expenses of soil testing would either consume the lion's share of, if not exceed, any carbon credit revenue generated from the increases in soil organic carbon.

[1] Spectrum Analytic. n.d. Why Labs Have Different Soil Test Results and Recommendations. [online] Available at: <https://spectrumanalytic.com/doc/library/articles/why_labs_have_different_soil_test_results>; [Accessed 20 March 2022].

[2] Goidts, E., Van Wesemael, B. and Crucifix, M., 2009. Magnitude and sources of uncertainties in soil organic carbon (SOC) stock assessments at various scales. European Journal of Soil Science, 60(5), pp.723-739.

[3] <https://www.sciencedirect.com/science/article/pii/S034118622100059X>

[4] <https://agecon.unl.edu/carbon-farming-preliminary-economic-analysis-carbon-credits-no-till-and-cover-crops>

[5] <https://www.canr.msu.edu/news/precision-soil-sampling-every-farm-needs-it>

[6] <https://cropwatch.unl.edu/2021/pasture-and-forage-minute-grazing-stockpiled-grass-alfalfa-soil-sampling>

[7] Wallace Laboratories - soil testing, plant tissue, water analysis. 2022. Price List of Services / Fees - Wallace Laboratories - soil testing, plant. [online] Available at: <<https://wllabs.com/services/price-list-of-services/>>; [Accessed 20 March 2022].

[8] Wachira, A., 2022. The cents and sense in soil testing - FarmKenya Initiative. [online] Farm Kenya Initiative. Available at: <<https://www.standardmedia.co.ke/farmkenya/article/2001332387/the-cents-and-sense-in-soil-testing>>; [Accessed 20 March 2022].

[9] See the prices of futures contracts for nature based solutions, such as the CBL NGE0 - <https://www.barchart.com/futures/quotes/GIZ23>

Documentation provided by project participant

Revised ATBD document

DOE assessment

Date: 20/07/2023

This CAR is closed in this validation. However, FAR 01 is raised since the model validation report is not available.

CAR	38	Section no.	Section 2	Date: 07/06/2023
Description of CAR				
At the end of section 2; it is probably important to mention how the credibility of the technology has been established through peer-reviewed literature. In this case, since this is not, it is important to mention how this document provides evidence of how the technology might work. This means the process of validation will need to consider the evidence provided in a format that is comparable across standard existing methods. As mentioned in some places, some part of the technology is proprietary - it is important to mention what part it is and how and what is relevant to this project (PD).				
Project participant response				Date : 20/06/2023
Revised ATBD with proper information.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
This CAR is closed in this validation. However, FAR 02 is raised since the model validation report is not available.				

CAR	39	Section no.	3.7	Date: 07/06/2023
Description of CAR				
Section 3.7 mentions the use of the VIS-IR part of the spectrum - here again, vegetation is relevant to Mexico ranches and probably requires classification of the training (if not different training routines, distinguished results for the potential of the approach mentioned in the document with and without vegetation.				
Project participant response				Date : 20/06/2023
All Mexico ranches are continuously vegetated, and have similar vegetation (grasses, shrubs etc.). This is a native biome so there are no crop cycles. The ranches are never completely 'bare', although the vegetation density may be lower than in a typical cropland. As a result, there isn't any classification possible of the training data depending on vegetation.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and found justification appropriate and hence CAR closed.				

CAR	40	Section no.	4.1.1	Date: 07/06/2023
Description of CAR				
4.1.1. first paragraph; mention if the sample analysis or the sources were done using the Walkley Black method or loss on ignition.				
Project participant response				Date : 20/06/2023
This is given in the Northern Mexico-specific implementation overview, Section 5.1, for each of the 3 external data sources. The vast majority of data (INEGI and FMCN) are dry combustion and a minority (<10%) are Walkley Black.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	41	Section no.	4.1.3	Date: 07/06/2023
Description of CAR				
At this stage, it is necessary to systematically describe the area where this data or model training and testing was done. Please make the documents independent such that they are read completely and provide the full extent of relevant information. Further paragraphs go on describing the data limitations - it is hard to comprehend the extent to which it can limit or expand the model training and it is difficult to gauge the potential without the description of the data used and its sources. Thus, this section requires at the minimum a table outlining the metadata of the datasets being used.				
Project participant response				Date : 20/06/2023
Please see Section 5.1 for more information				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	42	Section no.	4.1.1	Date: 07/06/2023
Description of CAR				
Similar to 4.1.1; it is important to provide a tabulated list of satellite datasets used, their resolution, periodicity, duration of the data used etc. This is again crucial as highlighted in the previous section.				
Project participant response				Date : 20/06/2023
See Section 4.1.4. The satellite data table has also been updated with more data on resolution, periodicity, duration etc..				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	43	Section no.	4.1.3	Date: 07/06/2023
Description of CAR				
- Describe the procedure and logic followed in data cleanup in this section. A fixed set of criteria is necessary and must be applied uniformly across all datasets. Include a table of the number of data points before and after the cleanup procedure. - In this part of the text " However, given the number of soil tests used, we do not need to necessarily be able to identify these errors and remove them, as they are likely random errors and not systematic errors (as mentioned at the beginning of this section, only soil tests from reputable sources that are believed to have some level of sampling and testing standardization are used – samples taken by untrained individuals are not typically used)." What were the criteria for deciding on reputed sources? Do we have some data on the extent of analytical errors quantified for these laboratories? Are there measures of the extent of sampling errors? Please provide this information against each dataset used. Furthermore, when saying data from untrained samplers were not used generally, describe the cases when such datasets had to be used. Can these quality parameters be mapped onto the data points in the X:Y plot where empirically measured BD vs Boomitra approach measured SOC be identified? PP is requested to plot these as different panels so we can see if there are any systematic biases.				
Project participant response				Date : 20/06/2023
For this particular region, Northern Mexico, no data points were actually removed during the cleanup as the data was itself good quality and every data point passed the criteria. This is mentioned in the 3rd paragraph in Section 5.1. The main checks are just the range in soil carbon, and the location (should not be in a built area Eg. A house, checked using ESRI LULC as indicated). These are the set of criteria, and are consistently done for every dataset in the same way. If you				

wish, we may remove section 4.1.3 for Mexico since no issues were found and the dataset is unchanged. The section is included for completeness.	
2. Data from untrained samplers are not used at all in this particular work. No such data was even evaluated by the team at any point. The only data that was evaluated was from reputed sources, which are defined here as government, reputed non-profits or for-profits doing work related to soil in the region, or peer-reviewed literature (see 4.1.1). As mentioned earlier, most of the training data, as presented in Section 5.1, comes from dry combustion studies, so the analytical error is believed to be low, 0.01wt% or less, which the methodology also supports. Sampling error isn't quantified in these datasets. As long as we have accurate geocoordinates, we don't have a palpable sampling error entering into the ML model since model training is done on a satellite pixel level – each soil test value is matched with the satellite pixel data of that exact location, and not any other satellite data.	
Documentation provided by project participant	
Revised ATBD	
DOE assessment	Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.	

CAR	44	Section no.	4.1.4	Date: 07/06/2023
Description of CAR				
1. there is a need for a section clearly describing the spatial extent of pixel size, empirical samples available, and the density of those samples across the project area - maybe a map showing the number of samples across the project area as scatter plots. Classify them as different shapes based on data quality and scale the intensity of colour such that higher intensity indicates higher BD. Out of the dataset, what proportion of the data had BD and what proportion had only SOC from which BD was back calculated?				
2. It is ideal to summarise the satellite data described as a simple table (also highlighted before). Table 1 is very generic.				
Project participant response				Date : 20/06/2023
1. See Section 5.1. there is a revised figure which covers plotting the soil samples on a map, and the data points are colored by their SOC level for easy identification of the distribution and range. The number of samples, pixel size, and data quality are clarified separately in that section. The data quality for almost all of the data is the same. All samples were taken by systematic soil sampling and soil testing by reputed sources. 95% of the data is from dry combustion analysis etc. (<5% is from Walkley Black). All data has both SOC and BD.				
2. There is a Mexico-specific Table 2 now in Section 5.1.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	45	Section no.	4.1.5	Date: 07/06/2023
Description of CAR				
Please again indicate the proportion of the data that had to get the depth adjustment. This section is prescriptive. Rewrite it such that what was done is clearly described. If multiple approaches were followed, mention those, describe and provide details of the proportion of data (for all data sets used).				
Project participant response				Date : 20/06/2023
It turns out there was no depth adjustment used for this particular work. We have deleted that section since it does not apply for this project.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	46	Section no.	Figure 3	Date: 07/06/2023
Description of CAR				
Please increase the bin size to 0.1% rather than 0.5%. Provide additional information as figure sub-text on what data this is, which geography this data apply, land use, period, etc.				
Project participant response				Date : 20/06/2023
Revised in the ATBD document with appropriate data.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	47	Section no.	Figure 5	Date: 07/06/2023
Description of CAR				
Paragraph after Figure 5: Please provide details on what approach was followed for what bin of data as in Figure 3. This needs to be carefully assessed with data. When different models are trained, describe and provide the confidence or uncertainty of each model (separately for each bin) such that the effectiveness of the overall approach can be assessed.				
Project participant response				Date : 20/06/2023
This work for the Mexico uses a single end-to end machine learning approach as noted in Section 5.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	48	Section no.	4.1.8	Date: 07/06/2023
Description of CAR				
Please mention what specific algorithm/approach was adopted; avoid generic statements.				
Project participant response				Date : 20/06/2023
This is clarified in Section 5.1 now, under figure 11				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	49	Section no.	Page 31 in attached PDF	Date: 07/06/2023
Description of CAR				
The paragraph starting from the end of Page 31 in the attached PDF: Does this mean the model was calibrated to different depths?				
Project participant response				Date : 20/06/2023
The models are only calibrated to fixed depths (aka 30cm). However, equivalent soil mass (ESM) basis requires the usage of a constant soil mineral column, which itself can expand in depth very slightly as soil carbon increases and bulk density decreases. The derivation in this section is to provide a conservative calculation of the final soc increase in this context, under an ESM basis.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	50	Section no.	Figure 8	Date: 07/06/2023
Description of CAR				
can the figure be moved up front and described briefly before going into details of the step. Supplement this figure with quantitative details; e.g., periodic QA/QC - how frequent? similarly, expand all steps in the schematics.				
Project participant response				Date : 20/06/2023
Moved. Also the 'periodic QA/QC' has been replaced with just QA/QC. The QA/QC of each step is done by a different team member right after the original team member completes that step. And once the model is completed and pushed to production, it is archived.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	51	Section no.	4.2.1	Date: 07/06/2023
Description of CAR				
4.2.1 this is the kind of detail which needs to be expanded and provided throughout the document. Having said that, does this mean once-a-year data from a satellite with low revisit frequency is converted to 12-day frequency data? How well do they compare if there is a way to compare them? such questions addressed can provide higher confidence in the steps. Can some literature evidence be provided where a similar approach was followed with an estimation of the effectiveness?				
Project participant response				Date : 20/06/2023
Yes, this is known as a spatio-temporal fusion technique. This is further clarified in the same section, including estimates of effectiveness. Further references, including a review paper, are added.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	52	Section no.	4.2.4	Date: 07/06/2023
Description of CAR				
Please provide the extant and an estimate of the sorts of uncertainties associated with the three sources. Keep them comparable in %OC or bulk density and mention units always.				

Project participant response	Date : 20/06/2023
This is in 5.1.1. We have also added a separate section there on domain coverage and input data uncertainties now.	
Documentation provided by project participant	
Revised ATBD	
DOE assessment	Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.	

CAR	53	Section no.	Figure 9	Date: 07/06/2023
Description of CAR				
Figure 9 is not relevant to the Mexico project. Please provide data for Mexico. Especially the spatial variability and land parcel size as well as possible physical sampling density for the sites could be different. Thus, it is better to provide data or Mexico here.				
Project participant response				Date : 20/06/2023
Document revised with a figure using the Mexico data. However, note that given the spatial variability in native grassland ecosystems, and the large size of the area, the results are not very didactic, because they suggest there is not spatial correlation at all between any two soil samples.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and iustification found appropriate and hence CAR closed.				

CAR	54	Section no.	ATBD	Date: 07/06/2023
Description of CAR				
Include a clear line or two to mention where and or what component frequentist and Bayesian approaches were used.				
Project participant response				Date : 20/06/2023
Please see section 5.1.1 for more information.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	55	Section no.	4.2.5	Date: 07/06/2023
Description of CAR				
Provide an estimate of the MDS or even minimum detectable difference for the project; express these in %wt units as well.				
Project participant response				Date : 20/06/2023
As provided in Section 5.1.2, around 10 samples should be able to achieve an MDS of 0.3. 100 samples, as was carried out during the validation sampling, achieves an MDS of 0.03. A conservative minimum detectable difference of a ranch level is given at the end of Section 5.1.3 by using a Bayesian approach – 0.175wt% is found to be MDD for that ranch. The frequentist approach would yield an unrealistically low minimum detectable difference, as the ranch is very large and has large numbers of pixels within it.				
The calculation of a conservative estimate of the MDD on a project level thus requires the bayesian uncertainty to be computed for each ranch, and the resultant values further propagated to the final uncertainty result. Given that the specific uncertainty will be calculated with real values for each ranch in the monitoring report, the project level uncertainties and MDD can be evaluated at verification.				

Documentation provided by project participant	
Revised ATBD	
DOE assessment	Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.	

CAR	56	Section no.	Page 41	Date: 07/06/2023
Description of CAR				
last paragraph I think 20% OC is not a realistic filter. This needs to be lower.				
Project participant response				Date : 20/06/2023
During the time of modeling, this work directly used a 5% OC filter because the availability of data is not very good for greater the 5% and temperate grasslands themselves typically have OC in the 0-5% range (a reference is cited for this). This is now corrected in the section. 29 soil samples are removed because of this filter (<1%).				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	57	Section no.	Page 42	Date: 07/06/2023
Description of CAR				
Page 42: the penultimate paragraph on INEGI; what proportion of the data was processed like this?				
Project participant response				Date : 20/06/2023
This is added now. ~1000 soil samples that were too shallow were removed. These are not outliers, but rather ineligible data because their sampling protocol does not meet our model requirements.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	58	Section no.	All histograms images	Date: 07/06/2023
Description of CAR				
please bin the data into 0.1% OC rather than 0.5%. This applies to all histograms				
Project participant response				Date : 20/06/2023
Revised in the document.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	59	Section no.	Figure 10A	Date: 07/06/2023
Description of CAR				
Figure 10a: What was the number of data points>5%OC? What is the land use?				
Project participant response				Date : 20/06/2023
All the observed land cover for all points is native grassland. The points greater than 5% OC are dropped, as discussed earlier, and that led to a removal of 29 data points (<1%).				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023

Team checked the revised ATBD and justification found appropriate and hence CAR closed.

CAR	60	Section no.	5.1.1.1	Date: 07/06/2023
Description of CAR				
SE of 0.02% is too low - what components does this represent? Contrast this against standard methods.				
Project participant response				Date : 20/06/2023
All quantitative uncertainty sections have been updated to include a description of the components and a comparison to gold standard soil sampling and dry combustion methods. Furthermore, the descriptions of this standard method now also include estimates of sampling error, a key component of the conventional method, but not present to the same level for remote sensing. When sampling error is included, we find that the SE of 0.02wt% for remote sensing is comparable to what we would get by taking a composite soil sample of 10+ locations across a farm, combining both sampling error and dry combustion quantification error (<0.01wt%). In the specific case of the remote sensing, the SE of 0.02wt% has contributions primarily from input data noise and model imperfection, as noted in Section 5.1.1.1. Standard methods on the other hand have soil test-specific errors and sampling errors, as noted.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	61	Section no.	5.1.1.2	Date: 07/06/2023
Description of CAR				
Please provide the figure number; As in the text after figure x; the dataset has 27 points - the histogram seems to show a higher number. Please check.				
Project participant response				Date : 20/06/2023
the figure numbers are added now. The dataset has 27 points, but the vertical axis on the histogram is not data points – it is a count of monte carlo simulation outcomes falling within each bin, and there are 100 monte carlo simulations in this work for the Bayesian uncertainty calculation. As a result, the counts are higher than 27.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	62	Section no.	5.1.2	Date: 07/06/2023
Description of CAR				
Please provide details of the Agrolab. Location, etc. Just a name is probably not the best way to present. Mention any accreditation etc.				
Project participant response				Date : 20/06/2023
Agrolab (agrolab.com.mx) is located in Pachuca, Mexico. It is accredited to ISO 17025:2005, FDA and several other standards. These details are now added to the doc and in an accompanying foot note.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	63	Section no.	Figure 14	Date: 07/06/2023
Description of CAR				
What site does this represent - one ranch? what area? how many areas? What is the expected range of SOC in these? How were the sites selected? There seem to be almost four clusters of data. What does this reflect? A visual assessment reveals that for each cluster of a given SOC e.g., 3%, the satellite-derived results are at least 0.5-1% (range from ~2.1 to 3 % almost). What is the MDD for this dataset? The technology may be applicable to certain cases better than others; thus, it is important to quantify this.				
Project participant response				Date : 20/06/2023
These details have now been added to the text above the figure. This data is collected across 36 ranches throughout the project region. As is typical in soil carbon for grasslands, and as stated earlier, the range is expected to be 0-5wt%. The sites were selected at random by computer algorithm for each stratum, after the project was stratified by soil texture type – for the 4 soil texture types in the project. The variation for each cluster you have noted is the primary contributor to the RMSE present in this validation data set. This rmse value is 0.3970wt%, which, as you said, is related to the 0.5wt% variation you see by eyeballing each cluster. The MDD for a 5 acre farm, using this validation dataset as the estimator of pixel-level uncertainty, would be 0.11wt%.				
These details have been added.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	64	Section no.	Figure 15	Date: 07/06/2023
Description of CAR				
please separately provide the KML for this polygon used in this figure 15?				
Project participant response				Date : 20/06/2023
Provided the KML.				
Documentation provided by project participant				
KML				
DOE assessment				Date: 20/07/2023
Team checked the KML and found appropriate and hence CAR closed.				

CAR	65	Section no.	Figure 16	Date: 07/06/2023
Description of CAR				
Plot overall trends and the slope of the curve. It is reasonable to plot a linear regression line. You can also plot the absolute mean or median for each year (or for the ideal month mentioned above) and then plot a regression line. Reduce the axis title size or better readability and make the data points open circles for better visibility.				
Project participant response				Date : 20/06/2023
For the sake of clarity, we've added the ideal month averaged mean values by year in a separate figure below this figure. This separate figure also has a regression line and slope calculated through it, along with error bars for each point using the monte carlo simulation results outlined further below in the same section.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	66	Section no.	Page 51	Date: 07/06/2023
Description of CAR				
Mention the intervention implemented for better comprehension.				
Project participant response				Date : 20/06/2023
The intervention is a transition to a 7-paddock grazing rotation for each herd. This is now added to the beginning of the section				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	67	Section no.	Figure 17	Date: 07/06/2023
Description of CAR				
Requested PPD to make figure better. may be considered colour and make the incremental changes a stark different colour.				
Project participant response				Date : 20/06/2023
We have increased the contrast for now to make things more visible. We will explore the color changes as well.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023
Team checked the revised ATBD and justification found appropriate and hence CAR closed.				

CAR	68	Section no.	NA	Date: 07/06/2023
Description of CAR				
In general, what is the upper saturation point for SOC increments? Compared to the project period, in how many years do the SOC stocks be saturated? There should certainly be an upper ceiling. With this increment, does the PP proposes to do verification every 4 years? This example provides a lot of insights to make such decisions. Please discuss this at the end of this section.				
Project participant response				Date : 20/06/2023
As discussed earlier, the range of SOC in temperate grasslands is 0-5wt%. Hence, in a *natural* temperate grassland system, SOC levels approaching 5% can be considered close to saturation.				
For this ranch, currently at 2%, with a 0.055wt% slope of SOC vs years, it would take 55 years to reach 5% assuming the same slope can be maintained. It could take longer as the slope decays as carbon gets higher.				
With the 0.055wt% increment, compared to the observed standard error, the project may do verification every 4 years if it is wished to have soil carbon change be completed observable on each ranch individually. However, the verification can be done on a yearly basis, when the observability on the whole project level is considered. A 0.087wt% standard error per ranch, across 140 independent ranches in the first instance of this project, translates to a cumulative 0.007wt% standard error on a project level. This suggests that monitoring could even be done yearly on a project scale.				
This content has been added to the section.				
Documentation provided by project participant				
Revised ATBD				
DOE assessment				Date: 20/07/2023

Ok. The verification report would eventually provide actuals. Team checked the revised ATBD and justification found appropriate and hence CAR closed.

CAR	69	Section no.	Non permanence Risk Report	Date: 31/07/2023
Description of CAR				
The non-permanence risk report (NPRR) is not in line with the VCS rules and the applied NPRR tool v4. PP is required to make the following correction: 1. PP needs to justify “Opportunity Cost, Point “g” for the whole crediting period and not just for the baseline reassessment period. PP must check section 2.2.3 Table 3 point h of the AFOLU NPRR Tool and justify the mitigation option in line with the requirements. 2. The justification provided for “Opportunity Cost, Point h” is not in line with the VCS rules. This mitigation option shall only be selected when the project is protected by legally binding commitment to continue management practices that protect the credited carbon stocks over at least 100 years. PP must check Table 3 of the AFOLU NPRR Tool v4 and justify selecting this mitigation option for the proposed project. 3. The analysis for project longevity is incorrect. The AFOLU NPRR Tool v4’s section 2.2.4 must be checked by PP, and the analysis must be revised. PP is required to present the analysis in terms of the contract/ ownership it has over the area of the proposed project which is 30 years with the partner. 4. PP must refer to section 2.3.3 point 1 and justify for not considering WGI indicator for assessing the governance score of the host country. 5. It is unclear whether the non-permanence risk has been assessed for each geographic area specified in the project description. Per section 3.6.19 of the VCS Standard v4.4, AFOLU non-permanence risk analyses, where required, shall be assessed for each geographic area specified in the project description (for requirements related to geographic areas of grouped projects see the VCS Standard). Where risks are relevant to only a portion of each geographic area, the geographic area shall be further divided such that a single total risk rating can be determined for each geographic area. Where a project is divided into more than one geographic area for the purpose of risk analysis, the project’s monitoring and verification reports shall list the total risk rating for each area and the corresponding net change in the project’s carbon stocks in the same area. The risk rating for each area applies only to the GHG emissions reductions generated by project activity instances within the area. PP must check the VCS Standard requirements and revise the assessment as needed. 6. PP must check the overall rating per the revised analysis and reflect any changes in the impacted sections of the PD/MR and related documents (e.g., emission reductions and removals estimations, etc.).				
Project participant response				Date : 01/08/2023
1. Opportunity Cost section, point “g” has been revised proper justification. 2. Revised the report with proper justification. 3. Proper analysis is now added in the revised risk report. 4. WI indicator value has been updated in the respective section of the risk report.				

5. Proper justification provided in the report whether the non-permanence risk has been assessed for each geographic area specified in the project description.	
6. The risk report has been revised and the ERR has now been estimated per the revised risk report.	
Documentation provided by project participant	
Revise non-permanence risk report.	
DOE assessment	Date: 9/08/2023
PP has updated the non-permanence risk report. With requested changes and found satisfactory and hence CAR is closed.	

Table 3. FAR from this validation

FAR	01	Section no.	RothC Model	Date: 20/07/2023
Description of FAR				
Since the model validation report is not available at the time of validation, the following FAR has been raised for the next audit:				
The baseline SOC decline (accumulation) rates from literature ($-0.69 \text{ tCO}_2/\text{acre}/\text{year}$) /8/, albeit scarce, looks reasonable. However, the PP are advised to use appropriate stratification (based on soil type, management variation etc.), and bin the baseline SOC accumulation rates accordingly. Since these are ex ante estimations, these are acceptable; the verification reports should present the baseline data and stratification for any instance(s) that would be verified.				
Project participant response				Date : NA
NA				
Documentation provided by project participant				
DOE assessment				Date: NA
NA				

FAR	02	Section no.	Remote Sensing (ATBD document)	Date: 20/07/2023
Description of FAR				
Since the model validation report is not available and remote sensing usage model guidance is not available by Verra at the time of validation, this the following FAR has been raised for the next audit..:				
Since the technology applied in this project has not been established for its efficacy for measuring SOC changes in peer reviewed literature, at the scale the project is being implemented and more importantly the possible rates of SOC increments, the PP is advised to take the following steps.				
1) In the monitoring plan, incorporate standard methods (involving field samples and analysis using dry combustion method) for a reasonable number of samples in each strata as a QA/QC check such that the ERs (current state of SOC as proxy) can be compared against. This would build higher confidence and can further inform the technology and its wider applicability. 2) The PP is advised to incorporate the following in the monitoring plan to enable realistic measurement of minimum detection limits and minimum detectable difference; the latter would inform and improve the confidence on the SOC increment numbers.				

a. For such analyses, the PP is advised to quantify the analytical accuracy of the lab through blind replicates) b. and to analyze SOC standards (soil samples with known and certified SOC levels) into the batch of samples being analyzed sufficient enough to span the SOC ranges that could be measured. 3) To achieve the second point above, the PP is advised to create appropriate stratification of the project area such that uniform area with similar soils (SOC), management strata and physiography such that the number samples to be drawn could be optimized.	
Project participant response	Date : 08-1-2024
1. The monitoring plan QA/QC procedure has been updated to incorporate gold standard soil sampling and dry combustion testing for measuring SOC and BD levels to compare to satellite-based estimates during each verification event 2. The process to select labs for this analysis has been included in the monitoring plan. At the current time a single certified lab, Agrolab, is used, and it is foreseen that the project will continue using this lab for continuity. Agrolab has provided analytical uncertainty – based on their certification and equipment, the uncertainty in SOC% is <0.01wt% and the uncertainty in BD is <0.01ton/m³. In addition to Agrolab's uncertainty, we will use more conservative values from literature, such as 0.02wt% for the detection limit of dry combustion[1]. 3. The monitoring plan now includes a stratification approach for the soil sampling, in order for it to be an effective QA/QC for the remote sensing technology, taking into account the technology's theoretical framework These processes have been carried out for the first monitoring period in the validation soil sampling collected in 2022, and results are presented in PD Section 4.4.1 and ATBD Section 5.1.2. [1] https://anlab.ucdavis.edu/analysis/Soils/322	
Documentation provided by project participant	
Soil sample results from lab, Soil sampling protocol Revised PD and ATBD document.	
DOE assessment	Date: 10–1-2024
PP has used verra guidance (as per PRR finding 11) the criteria in Appendix 4 of VM0042 v2.0 is utilized to provide justification to FAR 02 and PRR finding 11.	
PP has edited the monitoring plan in the PD to incorporate regular stratified soil sampling before every verification event, as a QA/QC check for the current state of SOC, to compare the remote sensing against. The monitoring plan incorporates the usage of appropriate labs, and the first monitoring period uses Agrolab, along with analytical uncertainty estimated. The management plan now also provides the stratification strategy for soil sampling to ensure an effective QA/QC of the SOC state. Furthermore, the PP has shared other peer-reviewed publications that use remote sensing of SOC and BD along with their uncertainties. In addition, the specific approach used for remote sensing of SOC is also now currently under peer-review in a submitted journal manuscript.	
1. Comparison between remote sensing SOC values and direct field measurements taken in the first monitoring period is provided in the ATBD Section 5.1.3, and now also in the PD Section 4.4.1. 2. The project's remote sensing approach measures SOC on every pixel of every ranch individually. To ensure the approach is representative, the calibration data of the machine learning model is	

checked to be fully representative of the different conditions on the project. PP has presented the relevant data in Section 5.1 of the ATBD, and the evaluation of this data for representativeness across the different geographical conditions across the spread of the project is mentioned in the validation report in Section 3.3.6. Finally, as a part of closing FAR02, PP has updated the monitoring plan with the stratification approach for QA/QC soil sampling.

See section 3.3.6 for details analysis of the VVB assessment.

Hence FAR 02 is closed.

FAR	03	Section no.	1.14	Date: 31/07/2023
Description of FAR				
Section 3.1.4 of the VCS Standards v4.4 document requires that "Projects and the implementation of project activities shall not lead to the violation of any applicable law, regardless of whether or not the law is enforced."				
In section 1.14, PP claims that there will be no double counting and the PP is allowed to develop the project. From the description provided in section 1.14 of the PD it is also understood that the project area falls under the scope of Mexico NDCs.				
As of now there is no Mexico's regulatory framework for carbon market. However, in future (before the verification) if the host country proposes a regulatory framework then the PP is required to request an official letter from the Mexican government that allows the PP to develop the carbon project in the project area as well as trade Verified Carbon Units (VCUs) in the voluntary carbon market.				
Project participant response				Date : NA
NA				
Documentation provided by project participant				
DOE assessment				Date: NA
NA				

FAR	04	Section no.	Draft Model Validation report	Date: 25/09/2024
Description of FAR				
During VCS PRR review, VCS has identified in the draft model validation report and suggested to add a FAR to address the same during the verification.				
1. The project does not provide a procedure for harmonizing the data derived from the different methods (Walkley-Black and the dry combustion analytical methods) and obtained from different sources. This information needs to be provided in the final model validation report. 2. Proper justification needs to be provided why PP used RothC version 2cla6.3. 3. Details and justification need to be updated on the assumption that there exists soil cover of 100% throughout the year in the project scenario. 4. Proper justification needs to be provided for the project scenario's RothC calibration and model run approach in a manner that is compliant with VMD53 requirements and Quantification Approach 1 of VM42, which requires that RothC outputs be used to model SOC stocks throughout the project. Currently, as per how the draft Model Validation Report is written, it appears that RothC is not used to model SOC stocks and only used to assign SOC stock gains to years in between the measurements. This also leads to an unrealistic 1:1 line for the plot of predicted vs measured carbon stocks in the model validation report in the project scenario.				
As per VMD 0053 requirement, the final model validation report need to verified by VCS empanelled IME expert during verification purpose. Hence this FAR need to be closed during the next verification audit.				
Project participant response				Date : NA

NA
Documentation provided by project participant
DOE assessment
Date: NA
NA

FAR	05	Section no.	NA	Date: 18/02/2025
Description of FAR				
During the VCS PRR review, VCS has identified the need for further evidence associated with the calculation of the uncertainty of SOC stocks determined by the remote sensing AI and biogeochemical models. There is a gap between how the uncertainty from extrapolating point to pixel is accounted for, and to address this, VCS has suggested adding a FAR that needs to be presented by PP at the time of the first verification. The following criteria for uncertainty quantification are added for next verification: - Demonstrate the validity and quality of the remote sensing AI model by passing the following tests using in-situ soil samples collected via representative sampling in the project area: - Demonstrate sufficient coverage of model's predictions. At minimum, 90% of validation data (i.e., project area observations) must fall within 90% prediction intervals, - Demonstrate goodness of fit, where $R^2 > 0$ for all paired observations in the validation set, and - Demonstrate low bias such that the model's prediction error is minimal. At minimum, the model's prediction error is not significantly different from 0 under a two-tailed, one-sample t-test. - Conduct more robust Monte Carlo error propagation via the following: - Account for covariance in predictive distribution of SOC stock among units when generating distribution of Monte Carlo draws by parameterizing a multivariate normal distribution with a covariance matrix that describes spatial dependence among units for which the biogeochemical model will be run. - Ensure the uncertainty calculation includes both the uncertainty from the biogeochemical model and the remote sensing AI model. The IME model validation report must ensure that both elements of uncertainty have been incorporated appropriately. While the IME is not required to validate the remote sensing AI model, it must ensure the biogeochemical model's input uncertainties are correctly accounted for to accurately calculate error propagation for the biogeochemical model's outputs. For Action 1(b)(i): For a recommended approach to multivariate normal distribution, please see below: Let X represent the vector of SOC stock values across prediction support units. If there are n units, the SOC stock values can be modeled as a multivariate normal distribution: $X \sim N(\mu, \Sigma)$ where: $X = [x_1, x_2, \dots, x_n]$ is the vector of SOC stock values for each of the n units; μ = the mean vector of SOC stock values				

Σ is the covariance matrix that describes spatial dependence among units. Σ must be estimated by fitting a variogram to the predicted mean values of SOC stock within each prediction support unit.	
Project participant response	Date : NA
NA	
Documentation provided by project participant	
DOE assessment	Date: NA
NA	

APPENDIX 3: COMPETENCE OF TEAM MEMBERS

<u>Certificate of Competence</u>						
Name	☒ Mr. ☐ Ms.	Ma Paa Puratchikkanal				
Qualification Procedure	Fulfil the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.					
Appointed to work as:						
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert
Appointed	Yes	Yes	Yes	Yes	Yes	No
Appointed Date	27-04-2021					
Authorized to work as Technical Expert for:						
Authorized Technical Area	Sectoral Scope	TA Code		Technical Area within the scope		
	Energy industries (renewable - / non-renewable sources)	1.1		Thermal energy generation		
	Energy industries (renewable - / non-renewable sources)	1.2		Renewables		
	Energy demand	3.1		Energy demand		
	Construction	6.1		Construction		
	Waste handling and disposal	13.1		Solid waste and wastewater		
	Waste handling and disposal	13.2		Manure		
	Agriculture	15.1		Agriculture		
Authorized to work as Local Expert for:						

<i>Country/Countries</i>	India
<u>Compliance check by:</u> Anand S. R.	

<i>Certificate of Competence</i>						
Name	☒ Mr. ☐ Ms.	Stalin S				
Qualification Procedure	Fulfills the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.					
Appointed to work as:						
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert
<i>Appointed</i>	Yes	Yes	Yes	Yes	Yes	No
<i>Appointed Date</i>	27-04-2021					
Authorized to work as Technical Expert for:						
<i>Authorized Technical Area</i>	Sectoral Scope	TA Code		Technical Area within the scope		
	Energy industries (renewable - / non-renewable sources)	1.1		Thermal energy generation		
	Energy industries (renewable - / non-renewable sources)	1.2		Renewables		
	Energy distribution	2.1		Energy distribution		
	Energy demand	3.1		Energy demand		
	Waste handling and disposal	13.1		Solid waste and wastewater		
	Waste handling and disposal	13.2		Manure		
Authorized to work as Local Expert for:						

Country/Countries	India
Compliance check by: Anand S. R.	

<u>Certificate of Competence</u>						
Name	☒ Mr. ☐ Ms.	Rakesh Tiwari				
Qualification Procedure	<i>Fulfils the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.</i>					
Appointed to work as:						
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert
<i>Appointed</i>	No	No	No	Yes	No	No
<i>Appointed Date</i>	27-04-2021					
Authorized to work as Technical Expert for:						
<i>Authorized Technical Area</i>	Sectoral Scope	TA Code	Technical Area within the scope			
	Afforestation and reforestation	14.1	Afforestation and reforestation			
	Agriculture	15.1	Agriculture			
Authorized to work as Local Expert for:						

Country/Countries	India
<u>Compliance check by:</u> Anand S. R.	

<u>Certificate of Competence</u>						
Name	☐ Mr. ☒ Ms.	Zainab Hassan				
Qualification Procedure	Fulfils the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.					
Appointed to work as:						
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert
Appointed	No	No	Yes	Yes	No	No
Appointed Date	27-04-2021					
Authorized to work as Technical Expert for:						
Authorized Technical Area	Afforestation and reforestation	14.1	Afforestation and reforestation			
	Agriculture	15.1	Agriculture			
Authorized to work as Local Expert for:						

Country/Countries	India
<u>Compliance check by:</u> Anand S.R.	

<u>Certificate of Competence</u>						
Name	☒ Mr. ☐ Ms.	Dr. Francisco Gonzalez				
Qualification Procedure	Fulfils the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.					
Appointed to work as:						
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert
Appointed	No	No	No	Yes	No	No
Appointed Date	27-02-2022					
Authorized to work as Technical Expert for:						
Authorized Technical Area	Sectoral Scope	TA Code	Technical Area within the scope			
	Afforestation and reforestation	14.1	Afforestation and reforestation			
	Agriculture	15.1	Agriculture			
Authorized to work as Local Expert for:						
Country/Countries	Mexico					

<u>Compliance check by:</u> Anand S. R.	
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APPENDIX 4: ABBREVIATIONS

4KES	4K Earth Science Private Limited
AFOLU	Agriculture, Forestry and Other Land Use
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CL	Clarification Request
EB	Executive Board
ER	Emission Reductions
FAO	Food and Agricultural Organization of United States
FAR	Forward Action Request
FSC	Forest Stewardship Council
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel for Climate Change
ISO	International Organization for Standardization
KML	Keyhole Markup Language
MoU	Memorandum of Understanding
MP	Monitoring Period
MRV	Monitoring, Reporting and Verification
NDC	Nationally determined contributions
PD	Project Description
PP	Project proponent
QA/QC	Quality Assurance/Quality Control
SDG	Sustainable Developmental Goals
SOC	Soil Organic Carbon
tCO ₂	Tonnes of Carbon Dioxide
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard